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IMPACT OF AUTOMATIC DATA PROCESSING ON THE MARINE CORPS SUPPLY MANAGEMENT SYSTEM

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IMPACT OF AUTOMATIC DATA PROCESSING ON THE MARINE CORPS SUPPLY MANAGEMENT SYSTEM

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CHAPTER I - INTRODUCTION

CHAPTER I

INTRODUCTION

> When the history of our age is written, I think it will record three profoundly important technological developments:
>
> Nuclear energy, which tremendously increases the amount of energy available to do the world's work;
>
> Automation, which greatly increases man's ability to use tools;
>
> And computers, which multiply man's ability to do mental work. Some of our engineers believe that of these three, the computer will bring the greatest benefit to man.
>
> Ralph J. Cordiner

The role of the United States Marine Corps in national defense is to provide forces of instant availability, high mobility, trained and disciplined personnel, the finest weapons and equipment available, and a responsive supply system.[1]

The Marine Corps has always been a progressive organization with a well-earned reputation for meeting challenges of the future. With this thought in mind, aided and abetted by the profound prediction made by Mr. Cordiner, Chairman of the Board of Directors, General Electric, the basic theme for this thesis

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[1] W. P. Battell, Brig. Gen., USMC, "EDP and Marine Corps Supply," Armed Forces Management, July, 1959, p. 27.

has developed. The original inception of a paper on this subject has been in the incubation stage the past few months and, the more one is exposed to the revolutionary changes taking place in this rapidly developing age of electronification, the more convincing it is that now is the time to start developing a better understanding of these profound changes.

Ever-increasing pressure is being applied to both industry and government in order to keep pace with these technological developments and thus insure that the economy of our country will prosper. Innumerable problems prevail in any changing environment--industry is faced with such headaches as profit squeezes, labor disputes, more and more governmental controls, and higher taxes; government is having both international and intranational troubles. Any one of these enigmas proves a fruitful area for a research paper; however, to present a thesis, the field must be narrowed to a manageable one. An area in which lies a tremendous challenge to the entire government is the recently developed field of cybernetic management. Still, this is a vast area too wide in scope for a paper of this type. Condensing once again, a terminal selection was made pertaining to one small segment of this overall governmental problem. This is the area of automatic data processing in the United States Marine Corps.

Automatic data processing has caused a tremendous change in the methods and procedures for handling data throughout the entire Corps. As an analogy, the Marine Corps has advanced from the horse and buggy era through the eon of the Model "T" and Model "A" into the age of standard shift. This stage is fast

becoming obsolete due to the introduction of automatic devices. The transformation paints a fascinating picture and, at the same time, one of profound change with far-reaching effects. The growth of automatic data processing can be similarly profiled.

It is intended that this paper acquaint the reader with the evolutionary changes within the data processing field, beginning with its historical application to the Marine Corps, then tracing the changes brought about by the requirement for electric accounting machines up to and including the modern electronic computers in operation today.

The Marine Corps has had over two years of integrated data processing experience in supply management. There are actually two separate and distinct systems of electronic data processing in the Marine Corps; namely, a supply management system and a personnel management system. It is too early to evaluate the latter system as it has just recently been implemented; therefore, this paper is strictly concerned with data processing for inventory control.

One objective is to convince all Marine Corps personnel--line and staff, ground and aviation--that it is their responsibility to become familiar with and to understand the overall aspects of the automatic data processing system. This responsibility cannot be overlooked, regardless of duty assignment, for some phase of this system ultimately affects their organization.

The automatic data processing system affects all future planning--operational, financial, logistical, and so forth--not only in keeping pace in this rapidly developing era of limitless

electronification, but also in achieving the most effective, efficient, and economical use of resources.[2]

In view of the above rationale, there is a definite need for a brief, comprehensive document written in layman's language. This requirement exists for the large majority of Marine personnel who need to know the effects of this system on their organization and on the overall Marine Corps. Both data processing and supply manuals are available, but since they are written for the technician and specialist, much is left to be desired by the reader who is not familiar with the technical jargon utilized in current published material.

This thesis, therefore, has a two-fold purpose: (1) the development of a non-technical paper which integrates the pertinent points of both data processing equipment and the Marine Corps supply system; and (2) in so doing, establish a document which can be used by personnel who, although having no requirement to become acquainted with the technical aspects as currently published in manuals, publications, and orders, nevertheless should know the general functions and characteristics of both the equipment and the supply system.

This paper commences with a brief sketch of historical developments leading up to the supply system as it exists in the Marine Corps today. The third and fourth chapters are devoted

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[2] C.J. Hitch and R.N. McKean, The Economics of Defense in the Nuclear Age, (Cambridge, Mass: Harvard University Press, 1960), Part II.

entirely to types, functions, and general characteristics of data processing equipment. The functions and characteristics are described by selecting pertinent data from technical publications and explaining the overall aspects in clear, concise, non-technical language. The fifth chapter illustrates how the Marine Corps has capitalized on this advancing era by designing an integrated data processing system for inventory control. This system utilizes equipment ranging from simple automatic devices up to and including complex modern electronic computers. Chapter six briefly describes future refinements planned for the automatic data processing system and is reserved for concluding comments and recommendations relative to the overall impact made by automatic data processing on the Marine Corps inventory management program.

CHAPTER II

THE MARINE CORPS SUPPLY SYSTEM

Historical Background

In order to present a complete picture of the Marine Corps supply system, it is necessary to turn back the pages of history to legislation of 1789. On July 11, 1789, an Act entitled "Establishing and Organizing a Marine Corps" authorized, among other things, one quartermaster to provide the required logistic support (including disbursements of monies) utilizing naval sources for Marine elements at sea and Army provisions and services for units ashore. This dual dependence continued until passage of the Act, "For the Better Organization of the Marine Corps," dated June 30, 1834. This Act established the Marine Corps as a separate service but placed it unequivocally under the Secretary of the Navy and under Navy regulations with a quartermaster and two assistant quartermasters to attend to the supply and financial functions. For more than a century the Acts of 1789 and 1834 governed the status of the Corps.

Prior to World War I, the relatively insignificant size and the simple organization and administration of the Marine Corps required only a rudimentary staff organization. Throughout its entire history, until the rapid expansion prompted by World War I,

the Corps had been administered by the Commandant, assisted by the Quartermaster and his two assistants, an adjutant, an inspector, a paymaster, a few officers and enlisted Marines; and, finally, a handful of civilians acting in a clerical capacity.

With the outbreak of the first world war the organization of the Marine Corps, in light of the growing complexity of warfare, became increasingly more intricate. The problem of expanding logistics dictated a high degree of specialization within the Quartermaster Department. The scope of the supply and logistics aspect of World War II, and the magnitude of expenditures required to operate a tremendously expanded Marine Corps served to entrench the Quartermaster as the financial and logistical mastermind of the Corps. He became, like the Commandant, a Presidential selection requiring the consent of the Senate for appointment.

Prior to World War II, Marine Corps accounting (supply, financial, and personnel) was accomplished entirely by manual devices. The advent of World War II and the rapid buildup of the Marine Corps to approximately 485,000 in 1945, along with the attendant problems of procurement, storage, issue, distribution and shipping, demonstrated conclusively that the old system was inadequate. The supply and logistics problems expanded beyond manual capabilities.

The Marine Corps being a progressive organization recognized its limitations and began searching for new and better methods of accomplishing its mission. The supply department immediately recognized the potential advantages of the electric accounting machines established by the personnel department at

Headquarters, Marine Corps, in June of 1943. The ever-increasing number of items required by the complexity of equipment and the new tactical concept emphasizing speed, mobility, maneuverability, dispersion, and deception made the manual system obsolete; thus dictating the requirement for voluminous up-to-date supply management reports. This increasing pressure for better and faster reports caused the supply department to establish a machine records section, first in the ordnance supply division during March of 1944, and in the signal supply division in November of 1945. Subsequently, in 1946, the machine records section, statistics division, personnel department and the two supply department machine records sections were combined. Thus the consolidated electrical accounting machine unit was established, functioning as a service unit to perform personnel and supply accounting. Such consolidation for service purposes has characterized machine record installations which have subsequently been established in the Marine Corps.

The requirement for data processing grew rapidly throughout the entire Marine Corps and, by the end of 1949, machine record installations had been established at all major supply centers, stations, bases, and recruit depots. It was during this period that the Congress became quite concerned with the tremendous increase in costs which occurred during and subsequent to World War II.

Title IV National Security Act Amendment of 1949

In 1947, the Congress established the commission on organization of the executive branch of the government--this

commission is more popularly known as the first Hoover Commission. In its report to the Congress in 1949, the commission stated that "the budget and appropriation process is the heart of the management and control of the executive branch . . . the maintenance of a huge military force and of enormous military budgets in peacetime posed a severe problem." It introduces a new element into our social and political life; this spending, both as a drain on the taxpayer and as purchasing power, can vitally affect our economy. The degree of our success in achieving efficiency of military operations and planning, economy in execution, and proper relationship of this new force to our political and economic fabric can make the difference between democracy and totalitarianism, both for our national well-being and for the whole world.

In the same year in which the Hoover Commission report was presented, the President approved, on the tenth of August, the National Security Act Amendment of 1949. The purpose of Title IV of the Act is "the promotion of economy and efficiency through establishment of uniform budgetary and fiscal procedures and organization."

Title IV indicated the recognition by Congress of the need for overall financial records of inventories in the military services. The law which reads in part . . . "the Secretary of Defense shall cause property records to be maintained, so far as practicable, on both a quantitative and monetary basis," required a reexamination of the role of financial accounting systems in inventory management. The impact of this law also caused greater use of electronic data processing and greater centralization of

inventory accounting and control which, in turn, brought about substantial changes in military financial inventory accounting systems.

A significant change caused by Title IV was the implementation of the working-capital fund.[3] During the implementation stages, it was pointed out that the working-capital fund is the most practical device to improve management with respect to the requirements of activities ordering common services and material, as well as with respect to the operations of industrial and commercial-type activities conducted by the military.

The use of working-capital funds simplifies the problem of budgeting and accounting for the cost of such goods and services, both by the ordering activities which are financed by appropriations and the producing or supplying activities which are financed by working-capital funds. Ordering activities are able to budget and account on an end-item basis for the cost of goods or services ordered and received, just as though they were purchased under contracts with outside suppliers.

This legislation resulting from recommendations submitted by the Hoover Commission was the first major step in government to put operations on a businesslike basis. National defense is a most pressing problem in which we devote tremendous amounts of our manpower and wealth. Congress wanted to insure that we work efficiently, spend wisely, buy what we need, and know what we have

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[3] U.S. Department of Defense, Supply Management Reference Book, (Washington, D.C.: U.S. Government Printing Office, 1958), p. 101.

in our inventories. Recognizing the size of the task, Congress, in August of 1949, passed Title IV which the Assistant Secretary of Defense (Comptroller) describes as follows:

> This Title really provides the machinery for placing the operations of the military services on a more business-like basis. No complete system was ever established--bits and pieces have been provided at times, but this is the first attempt, I think, to provide on an overall basis for business-like operations.[4]

Need for Management Information

Mr. Franz Schneider, in his testimony before the Preparedness Subcommittee hearings on implementation of Title IV, stated:

> Incidental to its military purposes, the Defense Department conducts the largest business in the country, if not in the world. Yet all this tremendous business is being carried on without benefit of the competitive urge or of the profit motive.[5]

Profits, which make dividends possible, are uppermost in the minds of any ordinary business manager or stockholder. Dividends from profits are the reasons for existence of the enterprise. All down the line in an organization the question is: How can we do this job better and more cheaply so as to lower cost of production, strengthen our competitive ability, and increase our profits?

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[4] U.S. Senate, Hearings before the Preparedness Subcommittee No. 3 on the Committee on Armed Services, Implementation of Title IV, National Security Act of 1947, as amended, 83rd Cong., 1st Sess., 1953, p. 2.

[5] *Ibid.*, p. 43.

Well-developed systems of accounting and statistical control make analyses of operational efficiencies automatic and the comparison of end results with those obtained by other similar enterprises is public for all to see. "If management is unsuccessful, it will be replaced by the directors or stockholders--or the enterprise will die."[6]

In the Marine Corps the incentives described above do not exist. With the exception of a few limited duty and reserve officers, all officers are unrestricted in duty assignment. Only a limited number of officers perform duty in a business-manager billet. The Marine Corps, in fact, holds to the theory that officers are all-around-men subject to continuous rotation in their employment. This is evidenced by the criteria recommended in the selection of officers for comptroller or fiscal billets. The guidance furnished indicates that the primary consideration should be the selection of those who have a broad military background of command and staff experience. The requirement for this method of selection is due to the fact that the Commandant does not intend that a Corps of financial management specialists be established in the Marine Corps.[7]

In addition to the above, the Commandant caused legislation to be passed which reassigned officers previously designed for

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[6] Ibid., p. 44.

[7] U.S. Marine Corps Order P7300.9, Marine Corps Commanders and Financial Management (Washington, D.C.: Government Printing Office, 1961), p. 11.

supply duty to a non-restricted field in the performance of duty in the Marine Corps.[8]

There are, of course, many cost-conscious and economically-minded officers doing their best to be business-like when on a management-type assignment. Such assignments are a passing phase in their careers, but not the primary criterion for judging their capacities and claims to advancement in their capacities and abilities as fighting men. The taxpayer has a right to expect the military to be cost-conscious, but this is secondary to training in leadership and preparedness in the event of war. Considerations of this kind undoubtedly prompted Congress to devise Title IV and its amendments. The effort was to bring a business attitude and business methods to the operations of the military enterprise; therefore, the following performance system of budgeting was outlined:

1. Working-capital funds were provided to enable businesslike management of manufacturing activities and inventories.
2. Management funds were outlined to permit operation of joint enterprises by the services.
3. An accounting system was laid down to parallel the budget system and the lines of management responsibility.
4. Provisions were made for a proper system of progress reporting, control, and internal audit.

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[8] U.S. Public Law, 87-123, 87th Congress, August 3, 1961.

The system outlined on the preceding page represents a profound change in the Marine Corps' information-gathering and management techniques. Title IV, applying external pressure, caused complete reevaluation of management within the Marine Corps.

There are many factors and principles in the application of management or command, one of which is that of decision making. Prior to making sound decisions, the manager must have information or premises. These premises must be of two kinds: (1) factual, and (2) of value. Their ultimate worth will be based upon their pertinence, validity, amount of factors considered, and their timeliness.[9]

The pertinence, especially the validity and the amount of material considered, operates in direct proportion to the time and amount of effort involved. The report may improve in value as it passes through the various organizational levels; however, each level requires a period of time so that when the information reaches the end manager, its value may have completely depreciated. There is also the technical problem of communication which ultimately causes the information to be distorted, altered, or misinterpreted as it passes through a number of persons. Additionally, the effort and work involved in considering a vast amount of information, though it may have only a slight casual

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[9] Manley H. Jones, Executive Decisions Making, (Homewood, Illinois: Richard D. Irwin, Inc., 1957), p. 59.

connection is often times more expensive than the cost of an incorrect decision.[10]

In the military, it is extremely difficult to place dollar values on management information when the life of Americans may be involved in the final decision. What is needed is a management tool that will provide the commander with the most comprehensive information, in understandable form, with accuracy and speed. This tool must account for the tremendous amount of items and factors that go into the makeup of this information and do this in the most economical way. In effect, it must provide management, or its counterpart, with the best information possible upon which to base a decision. Automatic data processing has the potential to give the commander this desired information and assistance. It will substitute "instrument flying" for "seat of the pants flying."[11]

Supply Management Program

Military supply management involves the largest inventories and the greatest diversity of items to be found in any organization in the United States.[12] Some of the problems in managing inventories arise directly from inventory size; others are associated with the range of items that are stocked. Many

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[10] David R. Anderson and Leo A. Schmidt, Practical Controllership, (Homewood, Illinois: Richard D. Irwin, Inc., 1961).

[11] Robert N. Anthony, Proceedings Data Processing Conference, (Boston, Mass.: Olympic Press, Inc., 1956), p. 3.

[12] U.S. Department of Defense, Supply Management Reference Book, (Washington, D.C.: U.S. Govt. Printing Office, 1958), p. I.

items are low in cost and easily acquired through normal commercial channels; others are high-cost items that can be obtained only through painstaking cooperation between the Marine Corps and industry. Some items are issued in large volume on a recurring basis, and the demand for them is relatively easy to forecast. Other items such as special types of ammunition and equipment have never been issued, so the demand for them is extremely difficult to forecast and may, in fact, never occur.

In addition to their size and variety, Marine Corps inventories are characterized by rapid and unpredictable changes in their makeup. The changes are the result of technological advances in the past generation that have revolutionized the art of war. There is every reason to suspect that technological change will accelerate, producing huge and complex problems for the military manager. Additional problems are posed by unpredictable changes in enemy capabilities and the world balance of power.

To understand fully the Marine Corps supply system, it is necessary to examine the principles under which it operates and the purposes for which it exists. Large business corporations operate successfully on the principle of decentralized authority and responsibility under centralized policy guidance. There is good reason for this. Experience has proven that it "pays off" in dollar savings, customer satisfaction, faster service, and greater efficiency. These factors are equally applicable to the Marine Corps. Important as they are, however, there is an additional factor which makes this principle "a must" for the Corps.

The Marine Corps exists primarily to protect and enhance the national security. To be successful, each supporting function such as a supply system must be tailored to fit the needs of that mission. Within this environment, then, the office of the Secretary of Defense develops and issues basic policies, but looks to each military service for the operation of that supply system which best fulfills its particular mission assignment within the policy terms set forth.[13]

The Marine Corps Supply System

The logistical support system of the Marine Corps has been largely shaped by its amphibious role, its status as a force-in-readiness, and its relatively small size. Also of major importance has been the close relationship of the Marine Corps to its sister service--the Navy. As is also true of the Navy, a sizable portion of the Marine Corps logistical load, both in supply and in services, is borne by the bureaus of the Navy.

The Commandant of the Marine Corps commands the Corps and this includes the task of logistics, administration, and control. The Quartermaster General of the Marine Corps is responsible to the Commandant for the management of the Marine Corps supply system, management of the Marine Corps stock fund, the disbursing of appropriated funds, and the administration of the Navy Industrial Fund within the Marine Corps.

The mission of the Marine Corps supply system is to provide assistance to the Commandant in the discharge of his duties

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[13] Ibid., p. 4.

by accomplishing the general functions of providing food, clothing, material, equipment, housing, and similar services. An integral part of the supply system is the Marine Corps stores system which provides financial and inventory management of all material financed by the Marine Corps stock fund and Marine Corps appropriation stores account.

The Quartermaster General of the Marine Corps, through the Marine Corps supply system, performs the following supply, managerial, operational, and technical functions:[14]

1. The Computation of material requirements.
2. The procurement, warehousing, distribution, shipment, repair, issue, sale, and control of all equipment, material, and supplies for the Marine Corps; except items specifically assigned to control of a bureau or another office of the Department of the Navy by the Secretary of the Navy.
3. Development of and participation in accounting and reporting systems designed to accumulate data for supply management, analyses, and action.
4. The procurement and administration of all services required by the Marine Corps, except those assigned for control to a bureau of the Department of the Navy by the Secretary of the Navy.

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[14] U.S. Marine Corps Order P4400.19, Vol. I, Marine Corps Supply Manual, (Washington, D.C.: U.S. Govt. Printing Office, 1961), p. 1-3.

5. Preparation and control of Marine Corps stock fund budget estimates and allotments, and preparation of budget estimates for other projects and programs under the control of the Quartermaster General of the Marine Corps.
6. Participation in supply management projects under Department of Defense cognizance, and
7. Implementation of directives emanating from the assigned defense supply integrated manager operating agencies as they pertain to the Marine Corps.

To support this mission the Marine Corps developed a unique logistical system designed to relieve each succeeding echelon of as much paperwork as possible. The system is composed of two inventory control points--one located at Headquarters, Marine Corps, and the other located at Marine Corps Supply Activity in Philadelphia, Pennsylvania; and two coastal supply complexes, each composed of a supply center and the stock account activities directly supported by the supply centers.

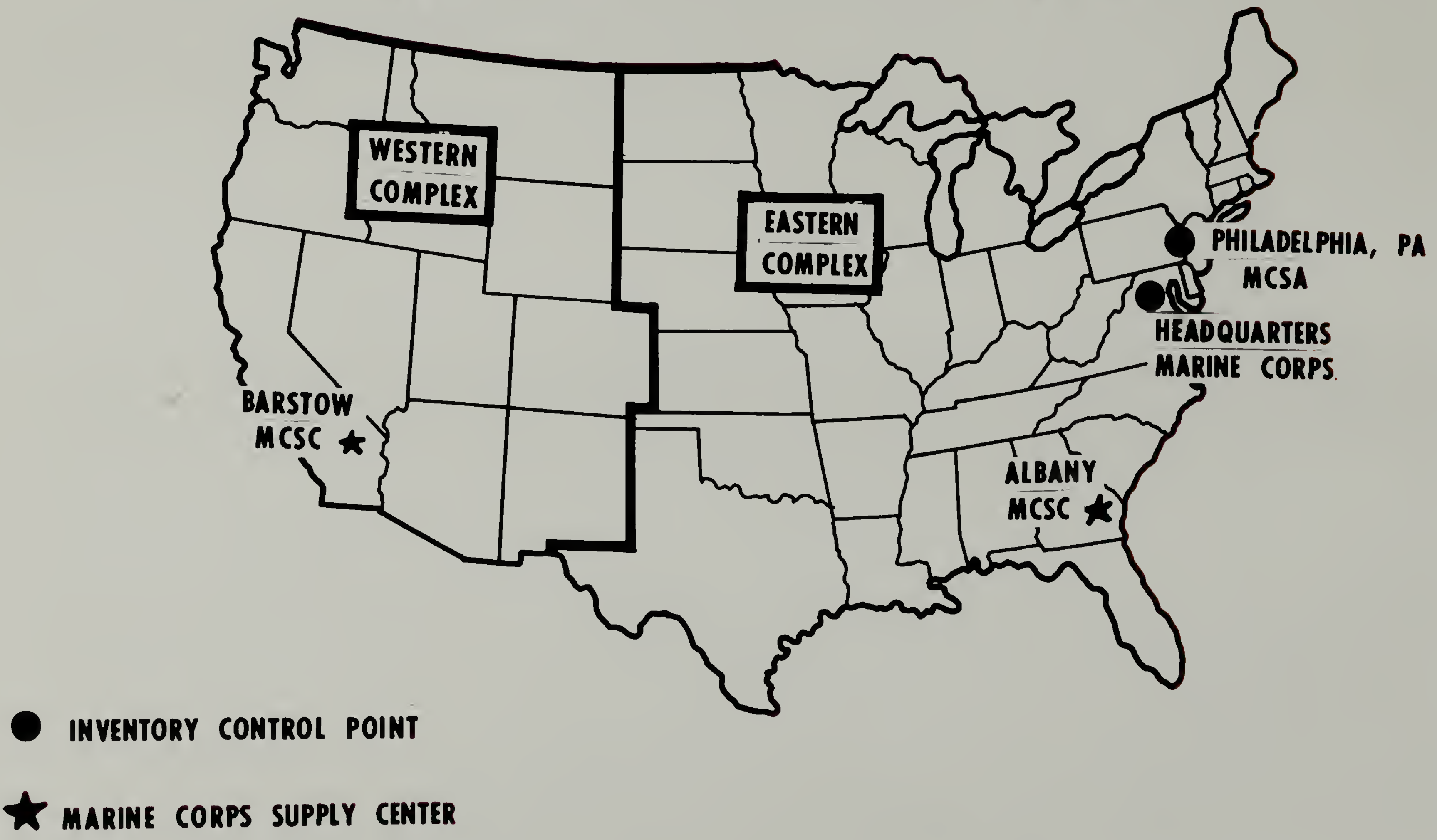
Generally, the inventory control point at Headquarters serves as the inventory manager for all the major equipment and major components. It also assumes responsibility for certain Marine Corps stock fund items including petroleum, oils, lubricants, dry-cell batteries, commissary stores, and subsistence items. The inventory control point at Philadelphia is responsible for control of all other Marine Corps stock fund items, including repair parts, maintenance items, and minor equipment--totaling about 300,000 items.

The stockage and distribution of Marine Corps supplies is accomplished by means of a bicoastal system with supply centers located in Albany, Georgia and Barstow, California. The two supply centers, as the major supply establishments of the Marine Corps, function as area supply centers for all major and minor supply items as well as repair parts. In addition, they are repair and manufacturing centers and, consequently, maintain a greater range and depth of stock items than do the stock accounts they support. To accomplish the supply mission, the United States has been divided into two distributive segments or complexes as illustrated in Figure 1. In general, the supply center at Albany is the source of supply for all activities located in the eastern complex including all Marine Corps units located in the Atlantic Ocean area, while the supply center at Barstow is the source of supply for all activities located in the western complex including all Marine Corps units located in the Pacific Ocean area.

The entire Marine Corps supply system is designed to centralize control of all operating stocks by means of the inventory control points. This system will, in the event of mobilization or war, give the operating forces immediate, accelerated responsiveness without any change in design or procedure. The Fleet Marine Forces have no capabilities to use multiple sources of supply which permit concentration on their primary mission of combat. The system allows requirements to be rapidly transmitted from the using level throughout the entire system by means of modern automatic data processing equipment.

FIGURE 1

MARINE CORPS SUPPLY DISTRIBUTION PATTERN



To manage the complex Marine Corps supply system, an integrated data processing network is required starting from the using unit level with somewhat simple equipment progressing to the requirement of more sophisticated equipment used at the supply centers. The next two chapters will describe functions and characteristics of equipment in use at various activities throughout the Marine Corps supply system.

CHAPTER III

ELECTRIC ACCOUNTING MACHINES

> The elimination of human drudgery
> will be accompanied only by the
> introduction of automatic tools.
>
> Aristotle

Introduction

This chapter and the ensuing one provide a general description of the functions and characteristics relevant to automatic data processing equipment used in modern mechanized accounting systems. These two chapters consolidate the results of extensive research and provide the pertinent points relating to the equipment functions and characteristics as contained in technical publications of various organizations. The material included herein is designed to acquaint the reader with the basic equipment used in the Marine Corps today and to further stimulate reading in this field. While detailed coverage of this subject is beyond the scope of this paper, such data are available in technical publications readily obtainable from the manufacturers of the equipment. The general descriptions of the machines which follow will include sufficient information for those personnel situated in decision-making assignments to obtain an overall understanding of the equipment involved.

Automatic data processing machines may be divided into two general groups: (1) punched-card accounting machines--sometimes referred to as electrical accounting machines or conventional tabulating equipment, and (2) electronic data processing machines--often called electronic computers. Punched-card accounting machines are widely used today and are familiar fixtures in many accounting activities both in government and industry. Electronic data processing machines, on the other hand, are relatively new although their usage is becoming more and more commonplace in both government and industry.

Historical Development

The Chinese abacus, figuratively speaking, is a computer and was invented over one-thousand years ago. It is simple in construction and operation and facilitates the processes of addition, subtraction, multiplication, and division. The abacus requires that a human hand guide it through each one of the steps in its operation. It is subject to the speed and accuracy of its operator. These and other limitations led to the early experiments and development of mechanical calculating machines. Charles Babbage, in the year of 1834, invented the "difference-engine"--a forerunner of today's electronic computer.[15]

The most significant contribution of the Babbage machine was its ability to carry out a predetermined sequence of mathematical operations and make limited logical decisions based upon

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[15] Harwood F. Merrill, (ed), Classics in Management, (New York, New York: American Management Assn., 1960), p. 28.

the results of its own calculations. By the year 1900, the basic principles of punched-card accounting machines were employed to handle the volume that business had generated, marking it an important milestone in the development of automatic data processing machines.

The advent of World War II increased the use of punched-card accounting machines by the military to tremendous proportions, and the use of this equipment has continued to grow steadily since the end of the war. The trend toward greater mechanization in the military as a whole indicates that administrative management is alert to the possibilities of increased efficiency and economy through greater mechanization, particularly in large-volume operations.

Experience has shown that a practical knowledge of punched-card accounting methods is an important prerequisite to an understanding of almost any automatic data processing application. Current mechanized accounting systems employ punched-card accounting machines exclusively, and electronic data processing systems rely on punched-card accounting machines for the preparation of data for introduction into the electronic data processing machine.

Electric Accounting Machine Defined

The term "electric accounting machine" used throughout this paper also defines the same type of equipment often referred to as conventional tabulating equipment or punched-card accounting machines. Regardless of the term used, the equipment performs the same functions.

Electric accounting machines are office devices used for recording and classifying, computing and printing, alphabetical and numerical, accounting and statistical information by electro-mechanical or electrical means. The source data to be recorded are reduced to coded holes punched in tabulating cards. These cards are introduced into the machines as a basis for processing the recorded information.

Electric accounting machines of the electrical system perform their functions primarily under electric control and derive their source data from punched cards (80-column capacity) under control of electric circuits. These circuits are completed by brushes that make an electrical contact through the holes punched in the card.

Electric accounting machines of the electro-mechanical system perform their functions primarily by mechanical action and derive their source data from punched cards (90-column capacity) under control of small pins which penetrate the holes in the card. Later models of these machines are designed to use electrical circuits as a basis for sensing the source data from punched cards.

To fully understand the vast scope of electric accounting machines, the general characteristics and functions of each piece of equipment found in a typical, conventional tabulating installation is discussed in the subsequent paragraphs of this chapter.

The Punched Card

The punched card is the basic communication medium for nearly every present-day mechanized data processing operation.

Almost universally, input and source data are originally introduced in electric accounting machine systems by means of punched cards. Information may be transferred from other types of source documents to punched cards or the punched cards may be used as the source document. Invoices, vouchers, requisitions, receiving notices, and stock-list changes on standard paper forms may be transcribed into punched cards for use in the electric accounting machine systems; or specially designed punched-card forms may be used for employee time cards or inventory count slips instead of the more conventional paper forms. The data in these punched cards may be sorted, rearranged, matched, combined, extended, and listed; but the punched cards remain the basic communications unit of electric accounting machine operations.

Punched cards are made in a variety of sizes and shapes, but each machine manufacturer generally utilizes a standard punched card for all of his equipment. The amount of data that can be placed in these punched cards also varies from one type of card to another, but punched-card capacities are usually standard for each manufacturer's family of equipment.

The card stock is of controlled quality which must meet rigorous specifications in order to provide strength and long life. This is necessary to insure the accuracy of results, the proper operation of data processing machines, and the continued usability of information long after it is recorded.

The card is divided into vertical areas called "columns" or card columns. The various letters of the alphabet (A to Z),

numbers (0,1,2, to 9), and special characters ($,%,#) are "written" by punching holes in the punched cards in the vertical card column. In order to accomodate any of the twenty-six letters in one column, a combination of punches is used. The various combinations of punches which represent the alphabet are based upon a logical structure or code. The various pieces of electric accounting machine equipment then read the data in the punched cards by recognizing both the number of holes in each vertical column and the position of the holes.

Once information has been punched into the cards, that information becomes a permanent record and cannot be changed unless additional holes are punched in the card or unless a new card is created reflecting the desired changes. Once the punching is completed, there is a lasting record which may be processed at machine speeds to obtain desired or required results; and the information, once recorded in a card, may be used time and time again.

Data Recorded in Punched Cards

Recording data by punching holes in punched cards can be accomplished by several methods. A card-punch machine is the basic method of converting source data into punched cards. This machine is commonly referred to as a keypunch machine. This machine, operated in much the same manner as a typewriter, causes perforations in the proper positions in a punched card as directed by an operator at a keyboard. The operator reads the source document and by depressing keys converts information into punched holes.

The machine feeds, positions, and ejects the card automatically. The operator's primary concern is to depress the proper keys in the correct sequence. The speed and accuracy of this method is entirely dependent upon the ability of the operator. This is basically the same kind of function as typing or as other key-driven operations. Card punches equipped with printing mechanisms automatically interpret the punched information by printing across the top of the card directly above the hole being punched. In addition, the majority of these machines will automatically reproduce characters from columns in a previously punched card to the corresponding column in a following card. This feature reduces the amount of manual operation when identical data are to be placed in a number of punched cards.

Another method of recording data in punched cards is the "mark sense" process. Marks are made in predesignated spaces on the face of a punched card by means of a special-type, graphite pencil. Electric accounting machines equipped with a mark sense device automatically cause the cards to be mechanically punched by electrically interpreting the special pencil marks and transmitting the data to a card-punching device. This process permits personnel who are physically located outside the electric accounting machine area to transmit source data to the data processing center without any special equipment other than the pencils. The card-punch machine and the mark-sense process are the most widely used methods of recording source data in punched cards. There are, however, several types of portable hand-punching devices that allow cards to be punched at the point of transaction. Such

devices are not in wide use due to the difficulty of adequately controlling the accuracy of the data punched into the cards by these methods.

Verifying Machines

Card verifying is simply a means of checking the accuracy of the original keypunching by repeating the keyboard punching operation which created the punched card on another type machine using a different operator. A second operator verifies the original punching by depressing the keys of a verifier while reading from the same source document. The machine compares the key depressed with the hole already punched in the card. Correctly punched cards are identified by a special notch placed on the side of the card by the verifying machines. A special notch directly above a column signifies the punching of that column is in error. The effectiveness with which the verifying process is performed is an important factor in the internal control of a punched-card accounting system.

Sorting Machines

Sorting is the process of grouping cards in numerical or alphabetical sequence according to any classification punched in them. In order to group cards by account number, they are sorted into account sequence. This makes possible the summarizing of cards by account. Data arrangement is accomplished on the sorter. There are three basic types of classification performed on the sorter--sequencing, grouping, and selecting. Sequencing is the process of arranging data in alphabetical or numerical order, either

ascending or descending; grouping is the process of arranging like items together; and selecting is the process of extracting a desired item or items of data from a larger file of data.

There are a number of different sorters which may be used ranging in speeds from 450 cards per minute to 2,000 cards per minute. The sorting operation is usually performed on one-column or punched-card character at a time, and the number of columns involved in the data being sorted governs the number of times the deck of cards must be processed through the equipment. Sorting machines are usually equipped with counting devices used to count the number of sorted punched cards, and some have devices similar to a typewriter which can be used frequently for printing out various statistical data with respect to the cards being processed.

Collating Machines

A collator is a machine which will allow two decks of punched cards to be processed simultaneously. This machine can merge two groups of cards into one sequentially arranged deck; match the cards from one deck against cards from another (segregating those which either do or do not match); check either or both of the decks for proper sequence; and perform many other clerical-type operations. Matching and merging operations can be performed at the same time if required. Matching is a checking function used to check the agreement between two sets of cards, while merging is the combining of two sets of punched cards into one set of given sequence.

Reproducing Card Punch Machine

Reproducing from one card to another is like copying from one record to another. Information from one set of punched source cards is automatically punched into another set of cards. These reproducing punches differ from the card-punch machine in that they only create cards based upon data fed to them in other punched cards. It is possible to cause these machines to emit a limited number of characters during the reproducing process. Selected columns of information or entire records may be transferred from one deck of cards to another automatically through the use of these reproducing card-punch machines.

Information for a master punched card can also be reproduced automatically into any number of following detail punched cards or entire decks of cards can be reproduced to allow data to be processed on two or more different machines at the same time. Another advantage of the reproducing process is that it permits the creation of "working" decks of punched cards which can be used in the processing operations while the original deck is retained for control purposes.

Interpreting Machines

Interpreting is the process of translating the meaning of the punched holes into printed information on the same card. Alphabetical or numerical information can be printed in many different positions on the same card from which it is read. Common data can be repetitively printed on a group of detail cards from punched information on a master card.

Interpreting is advantageous when punched cards are used as documents on which additional information is written or marked, or whatever reference to filing operations is involved. This translating or interpreting process is also necessary when punched cards are to be used outside the machine processing activity or when they are to be checked, filed, or otherwise handled manually.

Calculating Machines

Calculators are machines that perform arithmetical operations on basic data punched in cards. Calculating is the computing of a result by multiplication, division, addition, or subtraction. Any combination of these calculations can be performed usually in one run. Factors to be calculated may be read from each card, or series of cards, emitted by a device within the machine; or be developed by the accumulation of a series of calculations. One or several results are punched in each card or in a trailer card which follows a group of cards carrying the factors. Many routines allow automatic checking to prove accuracy of calculations. To check the punched results, for example, an "A x B" calculation can be crossproofed against a "B x A" calculation during the same run.

Accounting or Tabulating Machines

The basic purpose of the accounting machine is twofold: (1) to print alphabetical and numerical data from punched cards in an orderly, meaningful, and desired fashion; and (2) to total data by proper classifications. Accounting machines vary in the number of totals which may be accumulated at one time and they

also vary in speed and in processing capacity. These machines can be programmed to read cards and print information a line at a time on forms usually fed continuously through the machine. The machines can print one or more lines from each card or can be controlled to add, subtract, and crossfoot totals.

Printing is performed in two different manners--detail or group printing. Detail printing is the printing of information from each card as the card passes through the machine. The function is used to prepare reports showing complete detail about each transaction. During this listing operation the machine adds, subtracts, cross-adds, or cross-subtracts, and prints many combinations of totals. Group printing is the accounting machine function that summarizes groups of cards and prints the totals on a report. Totals may involve adding, subtracting, or crossfooting. Information read from punched cards is entered into counter units and, at the end of each group of cards, the totals are read out of the counters and printed on the report. This function is used in preparing all types of reports requiring summarized totals.

Summary Punches

Summary punching is the process of punching one card to represent the total of a particular group or classification of data. Summary punching is done by the transfer of totals and identifying data from the counters in the accounting machine to a machine which punches the summary card. The machines are connected for this operation by a cable, and the data are transferred prior to printing totals on the report form.

Summary punching is often of value in reducing the number of card passes. If three processing runs must be made to produce various statistics, quite often a summarization may be performed on the first run which will reduce the number of cards to be processed on the next two runs. In cases where cards are referred to visually for information, maintenance of summary cards reflecting account status will reduce error and time by eliminating the mental computation of new balances from previous balance cards and transaction cards.

Transceiver Machines

Punched-card data may be transmitted from one physical location to another through the use of transceivers. This equipment combines the features of punched-card readers and punches with sending and receiving devices so that punched-card data may be "read" at one place and transmitted to another place where a new punched card is created containing the same information as the original card. This remote punched-card reproduction is accomplished by transceivers which are connected by telephone, telegraph, or radio communication facilities. Transceivers are often connected in networks which place several remote punched-card accounting machine installations in communication with each other.

Although this method of data transmission allows for the remote reproduction of punched-card decks without the loss of the original deck at the sending installation, plus accomplishing this much more rapidly than it could by mailing punched cards,

the transceiver operation is considerably slower than the various magnetic-tape, data transmission devices which have been developed during recent years.

Instructing Electric Accounting Machines

It has been pointed out that the various types of electric accounting machines are capable of performing many clerical-type operations rapidly and with a relatively high degree of accuracy; however, these machines are unable to think or in any way exercise any judgment on their own. They must be instructed exactly in what to do, how to do it, and in what order it must be done. The source data must be properly placed in the input hoppers so that the cards will read into the machines correctly. The products or the results of the operation must be removed from the equipment and introduced into other machines, distributed to using activities or otherwise manually handled. The machines must be started and stopped and, in most cases, the electrical circuits inside the equipment must be externally connected in such a way that the necessary processing operations are performed in the proper order or sequence.

Panelboard wiring is the most common method of connecting the electric accounting machine's internal circuits in order that the desired processing operations will take place as required. A basic understanding of this instructing procedure (the principles of panelboard wiring) is of considerable value in the appraisal of electric accounting machine operations.

In the majority of the electric accounting machines an electrical impulse is aimed at one side of a punched card as it

passes from the input hopper into the machine. When a card remains unpunched, the card itself acts as an insulator and the impulse can go no further, but when a hole has been punched into the card, an electrical impulse is allowed to pass through the card and complete a circuit to a receiving device on the other side of the card. The position of the holes punched in the card determines which impulses are allowed through to complete circuits to receiving devices.

Those impulses which are received through the punched card are then routed to a special panelboard consisting of many electrical sockets called "hubs". The person wiring the panelboard (using special wires designed for this purpose) connects various hubs together in the same manner a telephone operator plugs wires into hubs on a telephone switchboard. This panelboard wiring operation causes the impulses received at the board from the punched cards to be sent to the various machine components as "instructions" for the performance of processing operations as called for by the impulses.

The flexibility of electric accounting machine equipment is generally dependent upon the size and complexity of the panelboards and the operators' abilities to wire these boards to attain maximum effectiveness. Personnel dealing regularly with punched-card accounting machine installations will find that a more complete familiarity of panelboard wiring techniques will be both interesting and extremely helpful in the performance of their functions.

Electric Accounting Machine Systems

Several electric accounting machine operations such as sorting, collating, and reproducing are normally associated in a particular sequence to form an electric accounting machine system. Such a system generally involves the use of several different pieces of equipment to process information from source data to final results. To correlate, an electric accounting machine system can be defined as a series of data processing operations on applicable electric accounting machine equipment, the arrangement of which produces required end products from specific source data. For example, punched cards may be produced from and verified against original handwritten source documents; these cards may then be sorted in specific sequence and grouped by type of activity; and, finally, the sorted and grouped cards may be extended, footed, posted, and summarized to produce some desired accounting record or other required result. This combination of processing operations on applicable punched-card accounting machine equipment constitutes an electric accounting machine system.

CHAPTER IV

ELECTRONIC DATA PROCESSING EQUIPMENT

> The human resource has one set of qualities possessed by no other resource: it has the ability to coordinate, to integrate, to judge and to imagine. In fact this is its only specific superiority; in every other respect--whether it be physical strength, manual skill or sensory perception--machines do a much better job.
>
> Peter F. Drucker

Background

Electronic computers are undoubtedly the most complex and expensive business tools ever devised, but a surprising number of companies are finding they cannot afford to be without them.[16] The tremendous surge of modern development and use of electronic data processing equipment (computers) for business purposes is a development of the early fifties. Before this decade a few computers existed, but they were used solely in scientific and mathematical computing operations. Subsequent to 1950, the growth of interest in electronics for business systems has been fantastic. A whole series of developments in equipment and systems design has since followed making it possible to adapt electronic systems to office routines (including routine decision-making operations) and

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[16] William Harris, "The Astonishing Computers, " Fortune, June, 1957, p. 136.

business management procedures. These technological advances have also facilitated the integration of closely related functions which, in turn, foster the development of advanced systems in the field of information processing, information retrieval, accounting, reporting, and analysis operations in management control systems.

The development of the new opportunities for management planning and control brought about by the electronic computer created ever-increasing demands on heads of government agencies for more refined, detailed, and voluminous data. The need for timely, accurate, and correlated data also becomes more acute in such a period of rapid, technological change. The Marine Corps recognized this problem about the time that data processing by electronic means became a reality for business and industry.

The Adams Board was established in 1955 to determine the following: (1) data requirements for effective Marine Corps administrative operations, (2) the most economical means of developing that data, and (3) whether it should be done by manual, mechanical, electrical, or electronic means. It was recommended by the Adams Board that electronic data processing equipment be authorized to process the great volume of data generated in the supply management and personnel management field.

Based on the approved findings, the Greene Board was established in 1956 to develop an inventory control system which would provide for maximum exploitation of the potentials

of electronic data processing equipment within the framework of a sound supply management system.[17]

The Marine Corps is faced with many new problems as a result of this introduction of electronic data processing. The equipment involved is complex and requires technically skilled personnel; however, management need not become an expert in electronics or mathematics. As with other technical areas of business, a manager can learn to deal with the problems involved by acquainting himself with the general aspects, capabilities, and limitations of the systems and methods. He can rely on the experts for details. His task is to select the experts and to administer their efforts so as to produce maximum benefits for the Marine Corps and the taxpayer.

For that cause, the purpose of this chapter is to assist the manager by describing the major characteristics of electronic data processing equipment as it is related to the United States Marine Corps.

Electronic Data Processing Equipment

Electronic data processing equipment differs from the electric accounting machines discussed in the preceding chapter principally in that electronic devices (such as tubes and transistors) are primarily utilized in the performance of the processing operations rather than electromechanical devices. These types of

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[17] U.S. Marine Corps Pamphlet. Data Processing in the Marine Corps, Prepared by the Marine Corps Data Processing Officer, (Washington, D.C., Govt. Printing Office, March 31, 1960), Appendix C, p. 1.

electronic machines are commonly, although not always accurately, called electronic computers. Even though the term "electronic data processing equipment" covers all types of electronic computers, the term as used in this paper will exclude those computers designed and used for processing scientific and engineering-type data.

There are many ways in which electronic data processing equipment or electronic computers may be classified or grouped. The two most common methods are: (1) by use to which the equipment is put--general purpose and special purpose equipment, and (2) by relative size--small, medium, and large-scale equipment. These groupings are somewhat general and the lines of demarcation are vague in some respects. In any case, personnel should become familiar with these general classifications as they are often used in describing electronic data processing equipment.

Electronic Data Processing Equipment Defined

Before proceeding further with the discussion of electronic data processing equipment, certain terms used in this paper will be defined. It is the lack of precise definition that is largely responsible for the confusion and misunderstanding so common among many people connected with these machines and educated to them by articles in the popular press. Furthermore, the definitions to follow are important because they constitute the basis for outlining the scope of this chapter.

Data processing is the manipulation and refinement of crude data so that it is appropriately structured for management

and general decision-making use. The electronic data processing machine is the "computer" part of the system.[18] In brief, the electronic data processing system is a machine system which receives, stores, manipulates, and records data without the interposing use of punched cards; a system which stores instructions internally for data manipulation; and a system which locates and controls access to internally stored data. Electronic computers use electric charges or magnetic marks to represent business information, to compute with it, to store the data, and to drive a printer which produces numerical or alphabetical characters in familiar forms on reports.

Electronic data processing equipment denotes machines designed essentially for the solution of statistical, accounting, or business-type problems. Normally, such problems are considered as rather simple insofar as the actual internal computer processing is concerned; however, the operation does require a large volume of data to be fed into the machine and also a large volume of data to be taken from the machine. The effect of these considerations on the design of electronic data processing equipment is to place the emphasis on the capacity of the auxiliary "input" and "output" devices in the equipment systems.

It seems expedient at this time to mention the fact that the real distinction between computers designed for business-type

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[18] Richard G. Canning, Electronic Data Processing for Business and Industry, (New York, New York: John Wiley and Sons, Inc., 1956), p. 74.

[illegible]

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operations and those designed for scientific and engineering-type computations is in the input-output devices. The latter (better known as automatic computers) usually requires limited input and output devices. The type of problem encountered in these operations entails complex, internal manipulation of the data within the machine.

Trying to define the electronic computer is like the blind man describing the elephant. "It is easier for the experts to talk in terms of the parts of the machine rather than the whole."[19] Assuming this to be true of the layman, the discussion will proceed with a description of the parts, rather than the machine *en masse*.

General Purpose Electronic Computer

The general purpose computer is a completely flexible device designed to operate in terms of very basic steps so that it can be programmed to perform almost any clerical operation. General purpose computers are characterized as electronic machines that do all types of arithmetical computations--add, subtract, multiply, divide, and obtain square root. In addition, they are capable of performing a large number of other operations--store data, compare items, prepare reports, transmit, read, write and so forth.

A general purpose computer may be regarded as a data processing center; one that is completely integrated and able to

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[19] George Kozmetsky and Paul Kircher, *Electronic Computers and Management Control*, (New York, New York: McGraw-Hill Book Company, Inc., 1956), p. 7.

perform all of the various functions of data processing such as receiving information, converting information, storing data, sorting data, collating data, computing data, transmitting data, and putting the data into a usable form or as readable printed output.

A general purpose computer, from a machine point of view, is a combination of devices. These devices are linked in a way which permits the machine to perform operations by manipulation and transmission of electrical charges or magnetic marks. From the functional point of view, a general purpose computer is a system which permits the user to process data for a large number of purposes. The general purpose computer has the ability to understand and perform a relatively large number of instructions. These instructions are selected and arranged by a "programmer"--one who directs the computer operation. Since these and many other instructions can be selected and arranged in many different ways to meet varying requirements, it follows that general purpose electronic computers are very flexible. Because of this flexibility, general purpose equipment is more widely used than special purpose equipment in application to business-type operations.

Special Purpose Electronic Computer

Special purpose electronic computers are limited by their design--which is, specifically, the accomplishment of one particular function. Since the purpose of such a computer is fixed, the instructions used to control the operations required are

permanently built into the equipment and cannot be altered to perform operations other than those for which it was originally designed. Special purpose electronic data processing machines usually operate at higher speeds than do comparable general purpose machines, since no time is required for reading and interpreting the operating instructions.

For example, American Airlines has a special purpose electronic omputer making plane reservations. Ticket sales, reservations and cancellations are kept up-to-date by a central computer. The clerk located in any ticket office determines space availability or the status of flights within seconds by means of feedback from the center computer. The Bank of America has installed a special purpose computer automatically servicing daily customer accounts, processing checks, plus handling a large number of mortgage loans and installment loans.[20] These are only a few of the functions performed by a special purpose computer.

The limited variety of functions it performs, both mathematical computations and business data processing functions, makes a machine special purpose; but, for certain operations, the special computer may out-perform a large scale, general purpose computer.

Large Scale Electronic Data Processing System

General purpose and special purpose computers may be further classified according to size and speed of computation plus

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[20] Walter Buckingham, Automation: Its Impact on Business and People, (New York, New York: Harper & Brothers, 1961), p. 24.

cost of equipment. There is a great deal of variation in the speed, size, and cost of electronic data processing machines both among different manufacturers and within each manufacturer's own family of computers. The terms "large", "medium", and "small-scale" are commonly used in an attempt to group computers based upon their size, speed, and cost; but, since new equipment is constantly being developed and introduced, machines will change from one group to another as they become relatively larger or smaller than the newer equipment.

Currently, large scale electronic data processing machine complexes generally rent for over $25,000 per month.[21] The internal operating speeds are extremely rapid--the time for most operations being measured in millionths of a second (microseconds); and they generally have the capability of storing at least 40,000 characters of data in their internal storage units or "memories."

These characteristics are not intended as standards of any sort, but they convey the generally-accepted meaning of the term "large scale computer."

A large scale computer complex is often called a system since it consists of a number of connected machines or devices. The typical large scale system will contain the "main frame" or the computer itself, along with numerous input-output devices,

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[21] U.S. Cong., House of Rep. Subcommittee on Census and Government Statistics, Report on the Use of Electronic Data-Processing Equipment in the Federal Government: 86th Congress, 2nd Sess., 1960, p. 61.

auxiliary storage units (such as magnetic drums and disk files) and various control devices used to monitor such auxiliary equipment under direction of the main frame. See Figure 2 for an illustration of the basic elements of electronic computers.

Medium Scale Electronic Data Processing System

Monthly rental rates on the medium scale equipment range between $10,000 to $25,000.[22] The internal operating speeds are fast--the time for operations being measured in thousandths of a second (milliseconds). The program repertoire is usually as large as that of the large scale equipment. This means that the medium size equipment can perform most of the operations of the larger computer, but does so ten to one-hundred times more slowly. These computers normally have the capability of internally storing up to 40,000 characters of information or data. Generally speaking the input-output equipment associated with these medium systems is composed mainly of card readers or punches and magnetic tape units. However, recent machines in the field, notably the Sperry Rand Univac File Computer, have made provisions for a large and varied input-output system to the general processing unit.

Both alphabetical and numerical information may be processed; but, in some machines, the use of alphabetical data decreases its effective storage capacity. Information is accepted from tape at 2,000 to 33,000 characters per second.

Machines in the medium category include the Burrough's Datatron 205, the NCR304, the IBM650, the Sperry Rand Univac

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[22] Ibid.

File Computer, and the RCA501 Computer.[23] At the present time, the Marine Corps has six medium computers installed--three Sperry Rand Univac File Computers (Model 1) for supply management and three NCR304's utilized for personnel management.

Small Scale Electronic Data Processing System

The small scale equipment generally commands a rental fee of less than $10,000 a month.[24] It is primarily designed for the solution of the large category of intermediate and smaller-sized problems that cannot be economically processed by hand or by desk calculator methods. It is also designed for problems not sufficiently cumbersome to utilize the full capacity of the large or medium scale computer. Problems of this kind are numerous. They demand less storage capacity and speed than those for which the large scale computers are needed. Small computers are designed accordingly with resultant savings in physical size and cost, and with an increase in operating simplicity. Except by comparison with their giant counterparts, small computers are extraordinarily fast and possess sufficient storage capacity and other features to permit a high degree of automatic operation. Generally speaking, the small computer does not require the long preparations and procedural changes which are associated with most large scale computer installations.[25]

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[23] Victor Lazzaro (ed.), Systems and Procedures, (Englewood Cliffs, N.J.: Prentice-Hall Inc., 1959), p. 341.

[24] U.S. Congress, loc. cit., p. 61.

[25] Lazzaro, op. cit.

Machines in the small category include the IBM 1401 card computer system, the Sperry Rand Univac step card computer system and the like. It is interesting to note that, as of June 30, 1961, approximately fifty-five percent of all computers directly utilized by the government were classified as small computers. The balance is about equally divided between medium and large computers. Also approximately eighty-five percent of the 524 computers used by federal agencies are rented from the equipment manufacturers. The Department of Defense ranks as the largest computer customer with 364 computers in use--approximately seventy percent of the government total.[26]

Common - Components of Electronic Computers

There are many differences between manufactured electronic computers. Each has its own particular characteristics; yet nearly all computers have certain components and similar relationships between these components. The major components of an electronic computer system can be divided into the following basic elements: (1) input, (2) output, (3) arithmetic and processing, (4) memory or storage, and (5) control. A diagram of the components common to most computers is shown in Figure 2 along with the normal relationships between these elements.

The source data (or that information which is to be processed by the computer system) are introduced through any of several input components. The control component (including the

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[26] U.S. Congress, loc. cit.

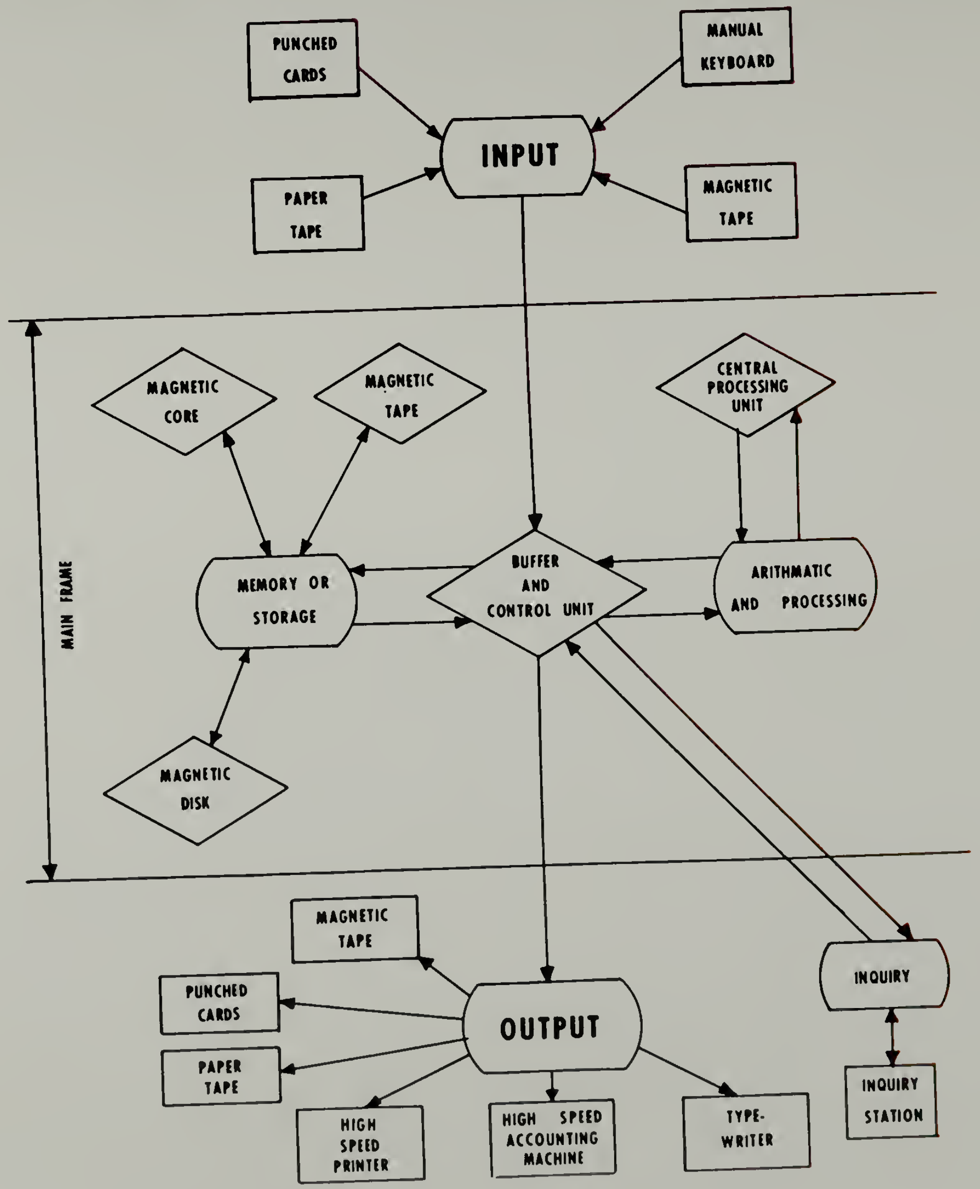
controlling mechanism within the computer main frame and the console or manual control unit which usually accompanies the main frame) tells the entire computer system exactly what to do with these source data and in what sequence the processing operations are to be performed. All logical decisions of which the computer is capable are made in the control component.

The memory component is the "storage bin" of the computer. It is in this component that computer operating instructions are stored until called for by the control component; source data are received and held until they are needed; intermediate results of processing are retained until they are called for; and final results or end products are constructed and stored until they are to be read out of the computer.

The arithmetic and processing component performs all of the required calculations and data manipulations necessary for specific applications as directed by instructions received from the control component. As shown in Figure 2, all of the raw material for the arithmetic and processing component's operation is generally received from memory and the results of these activities are returned to memory.

Finally, the output components receive all of the data to be read out of the computer from the memory component, also under the direction of the control component. These output components translate these end products into conventional letters, numbers, and signs from the special coding used within the computer and produce the desired reports, listings, punched cards, and magnetic tape records.

BASIC COMPONENTS OF ELECTRONIC COMPUTERS



Input Component Characteristics

It was stated earlier that one of the characteristics of business operations is the large amount of data required to be fed into the electronic computer for processing. To accomplish this the input equipment should have several desirable features:

> Manual effort involved in entering data into the electronic system should be reduced as much as possible, for reasons of speed, cost, and accuracy; where possible, make use of manual operations that must be performed for some other reason anyway.
>
> Input equipment should provide for detecting identification errors at point of input, wherever possible.
>
> Equipment may have to be designed to work with legal source documents, which must be retained for future reference.[27]

There are several types of input components used with computers. Input to the computer is usually thought of as comprising the original recording of data, the conversion to other media when necessary, and the actual transfer of data into the processing component. The most common input components currently in use are punched card readers and magnetic tape read-write units. Some computers, however, are capable of receiving data from perforated, paper tape through paper read-write units; and limited amounts of input data may be received through the manually operated keyboard on the console of some types of electronic data processing equipment.

Card readers receive conventional punched cards and send the data contained in these cards to the computer main frame when

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[27] Canning, <u>op. cit</u>. p. 247.

instructed to do so by the control component. Magnetic tape read-write units accomplish the same task with respect to magnetic tape data that card readers accomplish for punched-card data.

Card readers generally are slow in relation to the operating speeds of computers and, therefore, are seldom used for introducing large quantities of input data into computer systems. With card-reader speeds measured in terms of cards per minute and computer-operator speeds measured in milliseconds and microseconds, it is reasonable to assume that the input of any appreciable amount of data through a card reader would result in the computer spending more time waiting for data to process than actually doing the processing. Normally, paper tape read-write units are faster than card readers; but their speeds are not comparable to the input speeds of magnetic tape read-write units (currently the fastest input media). These magnetic tape units, although still much slower than internal computer operating speeds, are capable of transmitting data to the computers at the rate of thousands of digits or characters per second.

In an effort to achieve the highest possible input speeds, most computer users convert punched-card and paper-tape data into magnetic tape prior to the actual data introduction process. These card-to-tape and paper tape-to-magnetic tape conversions can usually be accomplished independent of the computer main frame on separate pieces of equipment in what are called "off line" operations. Therefore, this conversion can be taking place while the computer itself is operating on other data previously converted and introduced. In this manner, the most efficient use is made of the more expensive main frame time.

General Characteristics of Main Frame Components

It is difficult to generalize about the desirable features of the computer's main frame components. The desirable features are determined by the particular application so that any list of features must be recognized as controversial. The following list of desired characteristics of the data processor will at least provide a basis for discussion:

> The flexibility of a general purpose machine is desired for low volume work, such as exception items, new reports for management, statistical summaries, etc., and for making any management decision calculations.
>
> The high efficiency of special purpose circuitry is desired for high-volume, routine data processing such as file maintenance, sorting, shipping schedules, payroll and so forth.
>
> A logical method to interconnect or to relate the general purpose and the special purpose circuitry is desired.
>
> High efficiency of data storage in the external memory system is desired, combined with an efficient method for processing the data by the processing machine.
>
> A high degree of reliability is desired, both from the standpoint of long hours of operationg as well as from the standpoint of accuracy of answers.[28]

The control device determines if the computer is to read input, add or subtract, or store results. In order for the control component to operate, it must be given a prepared list of instructions. People who deal with computers call this set of instructions a "program."

The program is stored in the computer in magnetic or electronic form, just as is the information to be processed. The

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[28] _Ibid._, p. 267

program is entered by way of the regular input component. When in the computer, the program governs the operation of the circuitry. It tells the mechanism when and how to perform each individual step in the routine which is being performed.

The program must instruct the mechanism which item to read-off the input media, where to transfer it, what to do with it, and where to put the result. If any single instruction in the program is not correct, the machine will stop or give incorrect results.

The arithmetic and processing component of the computer is the backbone of the entire electronic data processing equipment complex. The processor takes instructions from the program. It can transfer data from one part of the computer to another. It can compare numbers and choose its next operation by jumping to different steps in the program automatically as a result of the comparison. One small example: While posting requisitions of inventory, it can initiate a purchase order if the inventory balance falls below the stored reorder point. Another useful ability of the logic device is that the control component knows when the computer has reached the end of a routine, and it will automatically start the next sequence or stop the machine.

The control tells the arithmetic unit which mathematical operation to perform and at what step in the process. The arithmetic element can add, subtract, multiply, and divide; shift decimal points; round off numbers and temporarily store results. In general, these operations can be performed at the rate of

several hundred to several thousand computations per second, depending on the size of the machine.

The memory or storage component holds data for later use in the operation of a computer. The input stores data in forms that can be brought to the computer. It transfers the data to temporary storage locations in the computer or directly to the main storage component.

The memory components may be constructed of magnetic cores, magnetic drums, magnetic disks, or any of a number of other materials; and they are capable of storing or retaining amounts of data ranging from only a few thousand characters to several million characters. The speeds with which data can be read out of these internal storage areas or memory components are commensurate with the computer operating speeds. Thus, once data has been introduced through an input component and placed in memory, this information may be called out of storage for processing and the results of processing may be returned to storage in milliseconds or microseconds without delaying the processing operations during the transfers. The time required to transfer data either to or from memory is commonly referred to as "access time." In addition to the components contained within the main frame, many computers are equipped with external console or manual control devices. A console, consisting of a panel of signal lights or other display devices, permits an operator to observe and monitor the computer operations. These consoles may also contain switches and a keyboard (similar to a typewriter) which allow the operator to manually instruct the computer when

necessary and otherwise communicate with the internal portion of the control component.

Output Component Characteristics

At one time output equipment was considered to be one of the major limitations in the processing of data. This criticism has been overcome somewhat with the latest developments in high-speed, output components. Some of the major, desirable features of output equipment include the following:

> Output should not be a bottleneck operation for the processing machine.
>
> Output equipment should be adaptable to standard business forms.
>
> The methods of output should provide legal copies of the data, when desired.
>
> The method of output should consider the future use of the data.[29]

The output components are the only means by which computers can communicate with the outside world other than through the inquiry station. It is through these components that the results of the processing operation are revealed. Forms of computer output include magnetic tape, perforated paper tape, punched cards, listings, printed reports, and documents. To produce these results the computer complex will contain such output components as card punches, paper tape punches, printers, typewriters, and the previously mentioned magnetic tape read-write units which are combination input-output components.

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[29] Ibid., p. 289.

As with the input components, the other types of output components are much slower than the magnetic tape read-write units. As a result most computer operations write their results on magnetic tape for later "off line" conversion to the other forms of output. While magnetic tape units write at the same speed as they read, card punches are generally slower than card readers. Printer speeds are usually measured in terms of hundreds of lines per minute.

The typewriter unit is seldom used for normal machine output, although it is generally connected permanently to the main frame. The reason for this is its extremely slow speed relative to the computer's operating speed. Therefore, this unit is usually reserved for exceptional types of low-volume output such as error messages, record counts, and special messages to the computer operator containing instructions for handling special situations which might arise.

Programming

Each electronic data processing system is designed to perform only a specific type and number of operations. It is directed to perform each operation by an instruction. The instruction defines a basic operation to be performed and identifies the data, device, or mechanism needed to carry out the operation. The entire series of instruction required to complete a given procedure is known as a "program."

For example, the computer may have the operation of multiplication built into its circuits in much the same way that

the ability to add is built into a simple desk adding machine. There must be some means of directing the computer to perform multiplication just as the adding machine is directed by depressing keys. There must also be a way to instruct the computer as to where in storage it can find the factors to multiply.

Further, the comparatively simple operation of multiplication implies other activity that must precede and follow the calculation. The multiplicand and multiplier must be read into storage by an input device. This device must previously have had access to the record or records from which these factors are to be supplied. Once the calculation is performed, the product must be returned to storage at a specified location, from which it may be written out by an output device.

Any calculation, therefore, involves reading, locating factors in storage, perhaps adjusting the result, returning the result to storage, and writing out the completed result. Even the simplest portion of a procedure involves a number of planned steps that must be spelled out to the computer if the procedure is to be accomplished.

An entire procedure is composed of these individual steps grouped in a sequence that directs the computer to produce a desired result. Thus, a complex problem must first be reduced to a series of basic machine operations before it can be solved. Each of these operations is coded as an instruction in a form that can be interpreted by the computer and is placed in the main storage unit as a stored program.

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The possible variations of a stored program provide the data processing system with almost unlimited flexibility. One computer can be applied to a great number of different procedures by simply reading in or loading the proper program into storage. Any of the standard input devices can be used for this purpose, because instructions can be coded into machine language the same as data.

Programming, the process of writing these instructions, is a complex, technical art requiring a thorough knowledge of the machine, its capabilities, limitations, and functions. Since computers are incapable of thinking, each step which they must take or operation which they are to perform must be carefully outlined for them or they will not function properly. For this reason, programs for even the simplest accounting operations require hundreds of individual instructions which cover even the most minute detail. In order to make the most efficient use of the computer, the programmer must select the instruction or

series of instructions which require the least amount of machine time for their performance.

Summary

There are a number of electronic data processing systems which can be obtained for business use. The majority of these are complete systems, produced by a single manufacturer. Others are made up of components from several manufacturers, although one manufacturer usually produces the major part of the system. The current systems are compact, modular, electronic data processing systems broadly expandable from small scale systems to ones with large scale capacities.

The two systems currently installed in the Marine Corps include some or all of the equipment characteristics described in this and the preceding chapter. Each of the systems contains equipment with abilities making it more suitable than other types for that particular function it is performing.

Almost all of the equipment described herein is available under leasing arrangements. The Marine Corps systems, currently installed, are under lease from three major companies: (1) The National Cash Register Company, (2) Remington Rand Univac Division of Sperry Rand Corporation, and (3) The International Business Machine Corporation.

The preceding description of data processing equipment, while not detailed, does present an overview of the types of machines used in this era of electronic data processing. Application of electronic computers has been made to a number of different data processing functions.

Successful experience in the Marine Corps supply management area has encouraged management to expand efforts into other fields. There is a general belief that electronic data processing will eventually dominate all record-keeping and communication systems in the management field. Regardless of the problems and difficulties inherent in its planning and control, electronic data processing has a great potential for the military.

The long-range plans and objectives of the supply managers, with their related controls, must be integrated. Thus, the next chapter discusses the accomplishments achieved in the Marine Corps integrated data processing system for supply management.

CHAPTER V

AUTOMATIC DATA PROCESSING FOR INVENTORY MANAGEMENT

> As we surpass our father's skill
> Our sons will shame our own;
> A thousand things are hidden still,
> and not a hundred known.
>
> Alfred Lord Tennyson,
> on Progress

Background

The rising tide of red tape is a major problem facing business and government. Without some radical solution to this growing jungle of red tape which has accompanied the mushrooming of business and government bureaucracy, we would be hopelessly entangled in a wilderness of communicative detail.[30]

Subsequent to passage of Title IV, the entire Marine Corps has been in a constant state of change developing new systems and procedures to cope with the business-type operations required by the implementation of the provisions and intent of this law. The most significant change has been in the supply and logistics area of the Marine Corps. The Marine Corps supply system and several of the significant developments which have transpired since its inception are discussed in the second chapter. In order to describe a solution to the radical change that has been taking place, an introduction to the types of electric

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[30] Buckingham, op. cit.

accounting machines is discussed in chapters three and four including a description of the most common types of electronic data processing equipment found in the Marine Corps electronic computer centers.

This chapter highlights the impact made by automatic data processing upon inventory management. The rapid growth in the development and use of this system is related in great measure to extensive research efforts undertaken in the past in connection with military supply processing applications of automatic devices.

The term "automatic data processing" used throughout this chapter applies to all types of equipment previously discussed. This terminology is also preferred by the Department of Defense and they urge its usage by all military activities. The Department of Defense recognizes the advantages of the automatic system approach and, therefore, has adopted the term automatic data processing systems rather than electronic data processing machines. Mr. Phillips, Director of Data Systems Review Division, Office of the Assistant Secretary of Defense (Comptroller), while speaking before the Fifth Annual Computer Applications Symposium stated:

> The Department of Defense desires to have the words 'automatic' and 'systems' emphasized rather than 'electronic' and 'machines' because these terms more nearly describe the total system approach which includes all types of electric and electronic devices.[31]

While researching data for this paper, it became increasingly apparent that the term automatic data processing system

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[31] C.A. Phillips, "Problems and Prospects of Data Processing for Defense," Proceedings of the Fifth Annual Computer Application Symposium, Oct. 29 and 30, 1958, p. 30.

is often misused; therefore, it might be useful to define its exact meaning. Ned Chapin, who is recognized as an authority in this field, defines the term as follows:

> Automatic data processing--obtaining input information in machine language as close to the point of origin as economically possible; processing the information by automatic computer and by other machines, without human intervention, as far as economically justified; and having the output information produced in accordance with the needs of management and the more advanced techniques of data processing.
>
> System--the combination of machine service, material service, and labor service to accomplish information handling operations in business as, for example, the method of processing orders for merchandise.[32]

This is the generally accepted definition used by the majority of writers when referring to automatic data processing systems and can be used to describe the current system of inventory control within the Marine Corps. It is obvious that those persons responsible for designing the Marine Corps automatic data processing system for inventory management were looking at the overall situation rather than the narrow implications of the task at hand.

General Information

The size and complexity of the Marine Corps automatic data processing system for inventory management has increased rapidly. For the most part, this has been due to advances in technology, the item population increase required to support equipment, and

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[32] Ned Chapin, An Introduction to Automatic Computers, (New York, New York: D. Van Nostrand Company, Inc., 1957), pp. 501-515.

other demands by higher echelons of government. According to the second Hoover Commission's Paperwork Management Report,[33] over twenty-five billion individual pieces of paper are created and processed in government operations annually. Many of these records are processed repetitively through several handlings, and the number of individual, detailed transactions which are transcribed and processed from these documents is enormously high.

Payroll and personnel accounting covering several million government employees--civilian and military--creates additional tens of millions of documents and transactions each year. In the military supply and logistics operations, the millions of items of inventory to be processed, maintained, and controlled result in additional hundreds of millions of transactions. It would be extremely difficult, if at all possible, to determine the Marine Corps' share of these transactions; however, the problem is the same as that of overall government.

There has been a tremendous mushrooming of reports and demands placed on the Marine Corps during the last few years, and the trend appears to be increasing. This growing demand for information and services has to be countered by increased efficiency in organization and data processing, if the process is to be kept within reasonable bounds of cost and speed of action.

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[33] Paperwork Management, Part I: A Report to the Congress by the Commission on Organization of the Executive Branch of the Government, January, 1955.

Current and accurate data systems in the supply management field are vital if procurement, equipment modifications, and maintenance costs are to be controlled. Advances in technology within this area have been a prime factor in increasing the volume and complexity of transactions. The number of line items of inventory required to support modern types of equipment has greatly increased. New types of vehicles and missiles have placed an additional burden on supply activities while, in some cases, the older types of weapons and vehicles have also remained in the supply and maintenance systems for long periods of time.

These and other factors have swollen the pipelines in the supply system with thousands of transactions affecting procurement, equipment maintenance operations, development of supply requirements, and establishment of controls over resources. The need for timely, accurate, and correlated data becomes more acute in a period of rapid, technological change in order to avoid wasteful procurement practices and the accumulation of large excesses of obsolete material.

Development of Automatic Systems

It was necessary in the past to achieve efficiency by a division of labor. This meant that a large operation had to be broken down into a series of steps, each of which could be handled by a single machine or person, or at best by small groups of machines or persons. The first major breakthrough for improvement in this procedure came in certain mass-production, assembly-line techniques. Groups of operations were integrated so as to produce an efficient flow of data.

The same type of advance which occurred in the factory is now being sought in the field of communications for the automatic processing of information. There was little hope of achieving this to any large extent until a method was invented for recording, transferring, processing, storing, and reporting large amounts of data automatically.

Punched-card equipment represented a step in this direction but a restricted one due to its limited ability to reach any item of reference data. Essentially, the only information immediately available by this system is that particular card being processed at a given moment. To reach information stored in another card, not in immediate sequence, takes several minutes. It becomes expensive to try to develop integrated systems wherein the search has to be repeated frequently for reference data not readily accessible in the immediate data being processed.

With electronic equipment each of the fundamental steps of recording, transferring, processing, storing, and reporting was speeded up immensely. The increase was hundreds or even thousands of times greater in some cases. This meant that, for the first time, it was feasible to consider systems wherein large amounts of data could be handled rapidly, and all phases of an operation could be treated more or less simultaneously. As electronic equipment processes large amounts of basic data (such as requisitioning information), it can also accumulate and prepare useful analyses of the data. It can even report on variations from planned activities and indicate that remedial action, previously predetermined, should follow if such variations occurred.

The use of analyses techniques is an important factor in the design of systems. In using these new techniques a mathematical model is built describing the situation. For example--when given the flow of orders, plus the known stocks in various warehouses and the known costs of distribution through various routes, such a system can instruct operators how, where, and how much to perform of a given operation.

The use of this new type of equipment does not mean that older methods can be completely eliminated. There is a place for each of the previously used systems--manual, simple machine, and punched card. The question is: "Where is it best to use each type?"

Electronic computers add another level of automation although, for certain jobs, a pencil and paper are still the best tool and the ordinary filing cabinet is still the best method of storage. Computers are not used merely as an addition to the present operating, administrative structure or as an end in themselves. They function best in a new, streamlined structure wherein all the aforementioned methods make a contribution. These were some of the basic factors influencing the Greene Board in the development of their plan for the present-day, integrated data processing system for inventory management in the Marine Corps.

Integrated Data Processing System

Three medium-size, general purpose Remington Rand Univac file computers are being utilized in order to support supply responsiveness, inventory and stores accounting. Both supply centers

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

have a Univac file computer, and the inventory control point at Philadelphia has both a Univac file computer and a small scale Solid State 80 Remington Rand computer.

The stock accounts, which provide direct customer support, maintain necessary records by use of electric accounting machines. A large number of the using units and all Fleet Marine Force service accounts below stock account level have a mechanized capability. These units are not in the stores system; however, they do have the capability of communicating in machine sensible form with the stock account rendering supply support. All Fleet Marine Force service accounts within divisions, aircraft wings, and deployed force service regiments have an International Business Machine cardatype installation or are supported by a mobile data processing platoon equipped with electric accounting machines.

In addition to the above, a customer maintaining manual records has the capability of communicating any requirement to his supply source by means of a single line item requisitioning document. This requisition is capable of being converted into a machine sensible document by mark-sensing or by key punching. The system approach then allows the input information to be collected in machine language as close to the point of origin as economically possible.

The entire Marine Corps supply system is mechanized from the point of origin--using unit--to the inventory control point. Data can be processed at the using level, forwarded to the stock account, and transmitted to the inventory control point by automatic machines without human intervention.

The entire stores system is connected by transceiver networks. Each stock account is equipped with transceiver equipment which is tied in to its supporting supply center and, in turn, both supply centers are connected to the inventory control point, Philadelphia, through the Army Switched Circuit Automatic Network, (SCAN).

The last link, which is now in the process of being connected, is a data transceiver link to major overseas units located in Hawaii, Okinawa, and Japan. When this network is connected, the entire Marine Corps supply system will be integrated to the point where requirements can be transmitted to the next higher echelon in this supply chain almost instantaneously. The functions of each echelon are organized in such a manner as to allow for a completely integrated automatic data processing system.

Fleet Marine Force Service Accounts

The service unit is the lowest supply level where mechanized equipment is economically justified. The service unit is an organic element of each Marine division and aircraft wing. It has the responsibility for providing direct supply support with all categories of items to all elements of the division or aircraft wing. It is the sole supply source for all items within a Marine division and for all Marine Corps items in an aircraft wing. It is the point of origin for initiating data into machine language. The service unit's data processing capabilities enable it to make issues, maintain up-to-date accounting records, and order replenishments from the stock account on an automatic basis.

A customer's requisition is usually submitted on a single-line item requisition form--also called a tabulating card. This card may have certain information prepunched into it such as organization number, requisition number, and the balance is filled in by pen, pencil, or typewriter. Regardless of how the information is entered on the requisitioning card, it is matched against the service unit's stock balance card upon receipt by the service unit. If there is a sufficient quantity on hand to fill the request, the stock balance card and the single-line item requisition are offset; certain machine codes are entered on the card by the stock reviewer; and they are then forwarded to the machine operator for processing. The machine operator will place both cards in the cardatype and, simultaneously, depress the keys on an auxiliary keyboard inserting the information previously coded on the card by the stock reviewer. The start button is pushed after all coded information is entered into the keyboard and, from this point on, all data involved are processed automatically.

For example, the cardatype automatically cuts an issue document to be forwarded to the warehouse. This document contains such information as quantity to be issued, unit price per item, extended price, customer number, requisition number, and warehouse location. The cardatype will also up-date the balance card. In other words, it will produce a new balance card containing up-to-date information such as new balance on hand, total cumulative issue to date, total quantity on requisition, and safety level of stock to maintain on hand at all times. Simultaneously, a transaction card is being automatically punched by the keypunch and a

continuous transaction register is being automatically typed by the typewriter. These data are produced by the cardatype involving two typewriters, a keypunch machine, auxiliary keyboards, and an arithmetic unit--all attached to a main frame or console. This entire accounting process is done automatically without human intervention, and the output information is produced in accordance with the needs of management. Such a process is a simple IBM cardatype operation. Similar results can be produced by the mobile data processing platoon's tabulation equipment.

Each Fleet Marine Force service unit is authorized either a mobile data processing platoon or a cardatype installation for automatic data processing. This unit is the primary step in the entire Marine Corps automatic data processing system. From this point on, supply transactions are processed by data tabulating cards punched with machine sensible information. The service unit generally forwards its data cards to the stock account by mail or similar means; however, if a transceiver were available, the data could be transmitted through the transceiver network.

At the present time all service units are located in close proximity to their supporting stock account which negates the need for transceivers; however, the overseas service units are in the process of installing transceivers which will enable them to transmit all supply data via the overseas data transmitting network.

Marine Corps Stock Accounts

The stock accounts are in effect an extension of the supply center. These activities carry centrally managed assets which are

incorporated in the Marine Corps stores account. Figure 3 illustrates the location of each stock account in relation to its supporting supply center. The supply center at Albany, Georgia, is the hub of the east coast supply complex and supports four stock accounts located at Marine Corps Base, Camp Lejeune, North Carolina; Marine Corps Recruit Depot, Parris Island, South Carolina; Marine Corps Schools, Quantico, Virginia; and Marine Corps Supply Activity, Philadelphia, Pennsylvania. The supply center at Barstow, California, is the hub of the west coast complex and supports three stock accounts located at Marine Corps Base, Camp Pendleton, California; Marine Corps Recruit Depot, San Diego, California; and the Marine Corps Base at Twenty-nine Palms, California. This supply center also provides direct support to overseas Fleet Marine Force service units located in Japan, Okinawa, and Hawaii.

The Commanding Generals of the bases and depots which have stock accounts are responsible for the following:[34]

1. Budgeting for, requisitioning, and maintaining authorized levels of locally-managed, locally-procured material.
2. Determining stockage objectives for major items which are not susceptible of stockage on a replenishable demand basis and providing these requirements to the supporting supply center.

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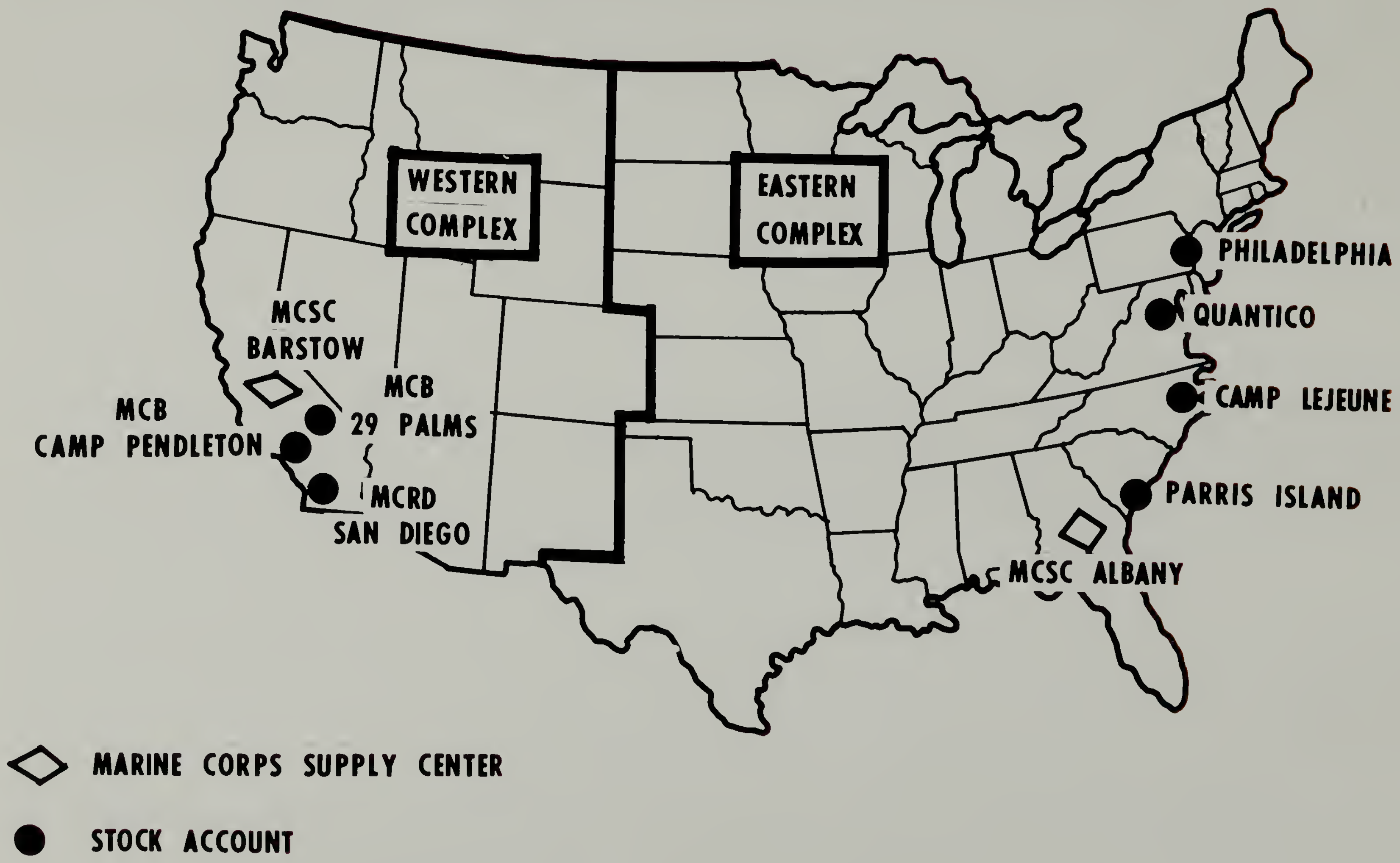
[34] U.S. Marine Corps Order P4400.19, Vol. I, Marine Corps Supply Manual, (Washington, D.C.: U.S. Government Printing Office, 1961), p. 1-9.

FIGURE 3

MARINE CORPS SUPPLY COMPLEXES & SUPPORTED STOCK ACCOUNTS



3. Ensuring that adequate supplies are stocked to support Fleet Marine Force and other assigned activities. It is the responsibility of supply centers to compute stockage objectives for supported stock accounts and to maintain a flow of supplies to meet the requirements of the stock account; however, this does not relieve the base commanders of the responsibility of taking appropriate action when computed stockage objectives and/or the flow of supplies from the supply center are not commensurate with the base commander's responsibilities.
4. Maintaining stock and local location and inventory records for such stock in accordance with procedures established by the Commandant of the Marine Corps.
5. Supplying support of Fleet Marine Force and other assigned activities in accordance with current directives of the Commandant of the Marine Corps.

These stock accounts provide direct customer support to division or aircraft wing service units and to separate units. They are the sole source of supply for all supported units in all categories of supply. Processing of supply accounting transactions by the stock account is accomplished by the use of electric accounting machine transaction cards containing all information necessary to up-date balance cards maintained by the stock

account, update computer records at the supply center, and produce the necessary documents, listings, and registers required by management. The majority of all supported units have the capabilities of preparing prepunched requisitions; therefore, the bulk of all processing in the stock accounts is accomplished automatically.

Accounting and financial records, which are maintained by electric accounting machines, produce a transaction card for each transaction processed. Daily, all transaction cards affecting inventory or stores balances are transmitted by the card transceiver into the computer room of the supporting supply center. In addition, all requisitions which cannot be filled immediately and all those assigned a high priority are passed by transceiver to the supporting supply center for action.

The daily transaction cards which are transceived to the supply center are the controlling media whereby the supply center controls and accounts for all supplies located in the complex stock accounts. These transaction cards tell the center when a certain quantity of an item has either been issued or received. They also relate to whom it was issued or from whom it was received in addition to the requisition number, voucher number and so forth. This method makes it possible for the supply center to keep an up-to-date inventory on all items in stock within the entire supply complex.

In addition, each stock account maintains stock balance cards for their particular account. In a sense, a duplicate record is being maintained, but is justified as an immediate

reference in case of emergency. There are numerous uses for these stock balance cards for internal management purposes. These records are necessary to process the reports and records required internally and they aid the commander in performing the mission heretofore outlined.

Marine Corps Supply Centers

A Marine Corps supply center is a major logistical establishment of the Marine Corps. It functions as an area supply center for all classes of supply; as an area repair center for all classes of supply; and, when directed, as a manufacturing facility. The supply center exercises technical direction over the stock accounts located within its coastal supply complex. For purposes of coordinating and expediting shipments of Marine Corps supplies to forces overseas, the supply center maintains liaison with overland, water, and air transportation activities.

The Commanding General of a Marine Corps supply center is responsible for the limited technical direction of his respective complex. This direction includes the following:[35]

1. Item accounting for material in designated financial reporting classes.
2. Computation of material requirements as assigned.
3. Control over the reporting of supply and stores transactions generally within the coastal complex.

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[35] Ibid.

4. Redistribution of material which is centrally managed and centrally procured; specified financial reporting classes, as prescribed by the Commandant of the Marine Corps.
5. Procurement as authorized by current regulations and directives (including requisitioning from integrated manager distribution points and General Services Administration outlets) to fill the requirements of supported stock account activities from centrally-managed items.

The Commanding Generals are also responsible for the automatic data processing system which accumulates supply accounting data for the coastal supply complexes located at the supply centers.

From the operational viewpoint, the supply centers are the nerve centers of the Marine Corps supply system. All data are channeled to and from these supply centers. They are the primary source of supply for all overseas units and the control points for each coastal complex. They also provide facilities and have the responsibility for storage of all categories of reserve material. The supply centers provide support to the stock accounts by means of a sophisticated computer program including 17,000 program steps in its instruction. This computer program has the following general features:[36]

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[36] U.S. Marine Corps Order 4440.14, Simplified Inventory Control Program, (Washington, D.C.: U.S. Government Printing Office, 1960), Part C.

1. The reservation of stock against planned program requirements which are entered in the record as an obligation against assets. Reserved stocks may include assets held for the mounting-out or resupply of the Fleet Marine Forces, assets held for planned initial activation, or repair parts held for the Marine Corps Repair Program.
2. The computation of requirements by selection and application of the formula to which an item has been precoded. A variety of formulae is used depending on item characteristics, procurement lead time, source of supply, or supply policy. For each item stocked within a complex, the tape record carries a separate inventory record for each stock account holding assets or history. This record becomes the basis for automatic supply based on the computer requirements formulae.
3. The process required when a stock account's assets equal or fall below its reorder point. The computer automatically takes action to produce the required material by the correct one of several programmed means, including ordering from integrated management sources.
4. The policing of performances in the stock account's activities plus insuring that the supply decisions reflected in the various substitutability codes and other codings are carried out.

5. The use of coded tape which stores nomenclature and freight classification information. This permits the preparation of complete shipping documents on a high-speed printer without the need for professional freight classifiers.
6. The accounting for value of material in "stores" which parallels the inventory program. Stores accounting transactions are by-products of inventory transactions and are produced from the same basic transaction document. The supply center computer simplifies stores accounting by combining documents which would otherwise represent a difficult manual matching process. Since unit value is contained in every supply document and is carried in the master inventory record, facilities exist for periodic trial balances of stores and inventory data.
7. The consolidation of inventory and stores accounting data for each complex and the submitting of such data to the inventory control points for further consolidation. The processing of all complex transactions is performed on a thrice-weekly basis, updating all portions of the data. These transactions are consolidated each month and forwarded to the inventory control point.
8. The procurement as authorized by current regulations and directives. This responsibility

> includes requisitioning from integrated manager distribution points and General Services Administration outlets to fill the requirements of supported stock accounts for centrally-managed items.

Marine Corps Inventory Control Points

As previously mentioned, the Marine Corps stores system includes two inventory control points--one located at Headquarters, Marine Corps, and the other at Marine Corps Supply Activity, Philadelphia, Pennsylvania.[37] The Commanding General of the Supply Activity in Philadelphia, under military and management control of the Commandant of the Marine Corps, is responsible for inventory control of all centrally-managed and centrally-procured items (other than subsistence, commissary stores, dry-cell batteries, petroleum, oils, and lubricants) which are procured under the appropriation Marine Corps Stock Fund, plus a limited range of appropriation stores account material. The Commanding General also performs functions, as assigned, relative to pricing, cataloging, reporting, and computation of mobilization reserve requirements for centrally-managed, locally-procured integrated manager items.

The responsibilities and relationships described are based upon the concept of a phased plan for the utilization of modern automatic data processing equipment to improve supply management.

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[37] Supra, p. 20.

Detailed responsibilities of the Commanding General, Marine Corps Supply Activity, include:[38]

1. Computation of requirements.
2. Preparation of budget estimates.
3. Procurement action.
4. Disposal action.
5. Development of inventory data.
6. Positioning or repositioning.
7. Cataloging of all items of Marine Corps material.
8. Maintenance of attained mobilization reserve stocks.

The annual budget-planning data prepared by Headquarters, Marine Corps, provide the basic assumptions and principle guide lines for determining peacetime and mobilization requirements. The Marine Corps Supply Activity determines individual item requirements based upon the planning guidance emanating from Headquarters, Marine Corps. The computation of requirements are accomplished by means of automatic data processing. This method of computation is utilized for the purpose of developing purchase requirements and for the positioning and/or redistribution of stocks to fill peacetime and mobilization reserve demands. This method is also used in the stratification of assets to determine item deficiencies in peacetime-force material requirements, mobilization reserve readiness, the status of economic retention levels, and the amounts of excess stocks.

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[38] U.S. Marine Corps Order P4400.19, loc. cit.

The Marine Corps supply management concept provides for the supply of Fleet Marine Forces and the supporting establishments on the basis of variable levels of supply. The operating level of supply, based on the principle of economic procurement quantities, tends to equate the "cost to order" to the "cost to hold." By virtue of its functions as a central control point, Philadelphia must maintain certain levels of supply throughout the supply system and must optimize the location of supplies for day-to-day operation. Maximum emphasis is given to the economic order quantity formula and the variable safety level; however, items purchased on a cyclic basis, short shelf life items, and similar exceptions are also given recognition. Consideration is also given to the needs of planned mobilization. These considerations are all part of stored program instructions which enable computations to be handled automatically within the computer.

The major tool employed by the Supply Activity in management of material is the stock status report. Due to the fact it is a vital element of item management, it is appropriate to discuss the present stock status reporting system in some detail. Daily transaction reporting by transceivers is accomplished from the stock accounts comprising the stores system to their respective supply center. This updates the magnetic tape stock records at the supply centers. Stock accounts update their balance cards daily by electric accounting machine methods.

Changes in area inventories are reported biweekly by the supply centers on magnetic tape airmailed to the Supply Activity. The significant elements of information reported are:

(1) replenishable demand, (2) outstanding obligations, (3) on hand, (4) expected receipts, and (5) number of times item has moved.

Under the stock status reporting system, the item managers at Marine Corps Supply Activity, through the printout of the stock status report, are furnished data on requirements (requisitioning objective, obligations, reorder point); assets on hand (serviceable, unserviceable, and earmarked stocks); assets due in (expected receipts); shortages; and overages. These data are identified by east and west coast supply center complexes and the Marine Corps supply system as a whole. The current reporting system does not provide for a breakdown of stock status data for the various stock accounts comprising the east and west coast supply center complexes. Stock status information on each of these stock accounts is currently known to the supply centers at Albany, Georgia and Barstow, California.

With respect to appropriation stores account items, stock status reporting follows the general pattern outlined above. Stock status data on appropriation stores account items received from supply centers are reported by the Supply Activity to the inventory managers at Headquarters, Marine Corps.

The inventory control point has a number of uses for the stock status report. For example, excesses are determined for the coastal supply center complexes on the basis of stock status reports. The supply centers, in turn, determine excesses of material at stock accounts based on their replenishable demand requirements versus assets on hand.

The point to be emphasized here is that the inventory control point performs a tremendous task in managing over a billion dollar inventory. The program is an integrated system which is made possible only by the utilization of automatic data processing devices.

Headquarters Marine Corps

The inventory control point at Headquarters, Marine Corps exercises stock control and procurement responsibilities for all appropriation stores account items of major equipment and certain selected stock fund items not managed by the inventory control point at Philadelphia.

Automatic data processing support for inventory and fiscal management data are furnished the Headquarters inventory control point by the computer center at Philadelphia. The items managed by the inventory control point at Headquarters, Marine Corps cover a relatively small range. The majority of all items in the Marine Corps supply system are managed by the inventory control point, Philadelphia. Headquarters, Marine Corps is in no way involved in the day-to-day operational functions of the supply system other than the few items they manage.

The offices of the Quartermaster General are primarily concerned with providing policy guidance to various elements of the supply system in order to assure maximum economical availability of stock and prompt efficient supply service to the operating forces.

Summary

The foregoing chapter deals with the impact made by automatic data processing upon the Marine Corps inventory control system. Emphasis, thus far, has been placed on the profound changes unfolding within the entire system. Even though a major breakthrough has been made, the entire field of automatic data processing is in an early state of development. The current data processing plan of the Marine Corps is one of initial acquisition in quantity of the first generation of feasibly useful and refineable equipment, and is considered to be the embryonic stage producing the first crude concepts and nuclei of equipment, personnel, and techniques to begin a natural and evolutionary movement toward adequate management information systems.

It would be reasonable to assume from progress made to date that the Marine Corps supply automatic data processing system has far surpassed original expectations as outlined in Secretary of the Navy Instruction P10462.7.[39] Nevertheless, the system has largely been used as a management tool for specific segments of the program rather than for a completely integrated procedure including all related functional areas. The full development of this system has far-reaching significance in terms of more efficient and effective utilization of all resources.

Major advances have been made in the inventory control area; however, it is time to conduct a comprehensive evaluation of

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[39] U.S. Department of the Navy, SecNavInst. P10462.7, Data Processing: In Navy Management Information Systems, (Washington, D.C.: U.S. Government Printing Office, 1959), p. II-2.

all experience gained to date in order to insure that full potential is achieved through development of an integrated system including all related functional areas. Future developments and potentials of integrated programming, budgeting, accounting, and reporting in this area are discussed in the subsequent chapter.

CHAPTER VI

THE FUTURE - A STATEMENT OF CONCLUSIONS

> The most serious deficiency in present-day computer installations, and indeed in present-day management itself, is the general reluctance of managers to think.
>
> E.D. Dwyer

Many erroneous conflicting impressions as to the computer's capabilities have developed over the past decade. The major weakness appears to be in the management of this whole revolution. The failure by managers to realize that the computer is not a panacea, actually increases demands on outstanding managerial talent. Developments in hardware have forged ahead of the needed parallel improvements in software--that is, our computer capabilities generally exceed management's abilities to use them most effectively.

> It seems a lot of people who are so eager to keep up with the parade and buy one of the marvelous electronic setups--apparently because they think it can do everything and do it a thousand times faster than any human being--seem to forget that these mechanical brains are so intelligent they can't do anything except exactly what they are told--a trait in common with most morons.[40]

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[40] Bill Borklund, "How We Mismanage the Mechanical Moron," <u>Armed Forces Management</u>, July 1960, p. 66.

This quotation adequately describes one of the major problems currently facing business and government. This point at issue will endure as more sophisticated computers are produced. Management talent is lagging far behind the progress being made in hardware and, in order to assure that future hardware is properly utilized, it is essential that accelerated training programs be established. Although this lack of training is not peculiar to the Marine Corps alone, immediate steps should be taken by the Corps to meet this challenge.

There are three levels or groups of Marine Corps personnel which have a definite requirement for such training: (1) top management and its staff--the decision-making level controlling the programs and procedures of the system, (2) the analysts--a group responsible for transforming management concepts from system and program development into requirements for hardware and further expansion of the concept into a definite plan, and (3) the personnel who will develop the plan and make the system and program an actuality.

It is the responsibility of these levels of management personnel to continually study, seek new ideas, and apply what they have learned. Although significant improvement has been made in respect to these responsibilities, progress is not keeping pace with the advanced equipment designs. This, in effect, appears to be the weak area in the Marine Corps automatic data processing system.

The current computer applications generally reflect a conversion of the old system rather than the development of a

completely new, integrated data processing system designed to capitalize on the unique capabilities of the computers. One of the widespread misconceptions concerning computers is the referral to them as "miracle machines" or "electronic brains." The term electronic brain construes a false idea that these machines can THINK; however, thinking is precisely what they cannot do. To be more exact, computers merely memorize or store information to be withdrawn and used at a later date. Refinements in the future will, no doubt, increase the memorizing capabilities of these computers. "Even more remarkable than memory, computers can learn."[41] Learning is defined by educators as a ". . . change in behavior that results from the receipt, storage, and use of information."[42] Thus, to learn, a machine must be able to receive information, store it, and then change or modify its behavior patterns in some way. This "learning" skill is prevalent in the newly developed parallel computers--combinations of two or three computers harnessed together and capable of coordinating coded information flowing through their circuits at the rate of two million or more pulses per second. The parallel computer will be able to tackle a number of business and scientific problems heretofore too long and costly for present-day computer application.

This equipment, while marvelous indeed, will never replace management. It is only a tool to assist management in the functions of planning, organizing, and control. Because of its

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[41] Norbert Wiener, The Human Use of Human Beings, (Garden City, New York: Doubleday, 1954), pp. 48-73.

[42] Buckingham, op. cit., p. 29.

robot-like operation, a computer can never be any more intelligent than the person who designs its program operations. It is faster and more accurate in the performance of its work, but its creative ability exactly parallels that of the programmer. It is, therefore, extremely urgent that the Marine Corps develop capable managers who will utilize this equipment to its maximal capacities.

Data Transmission

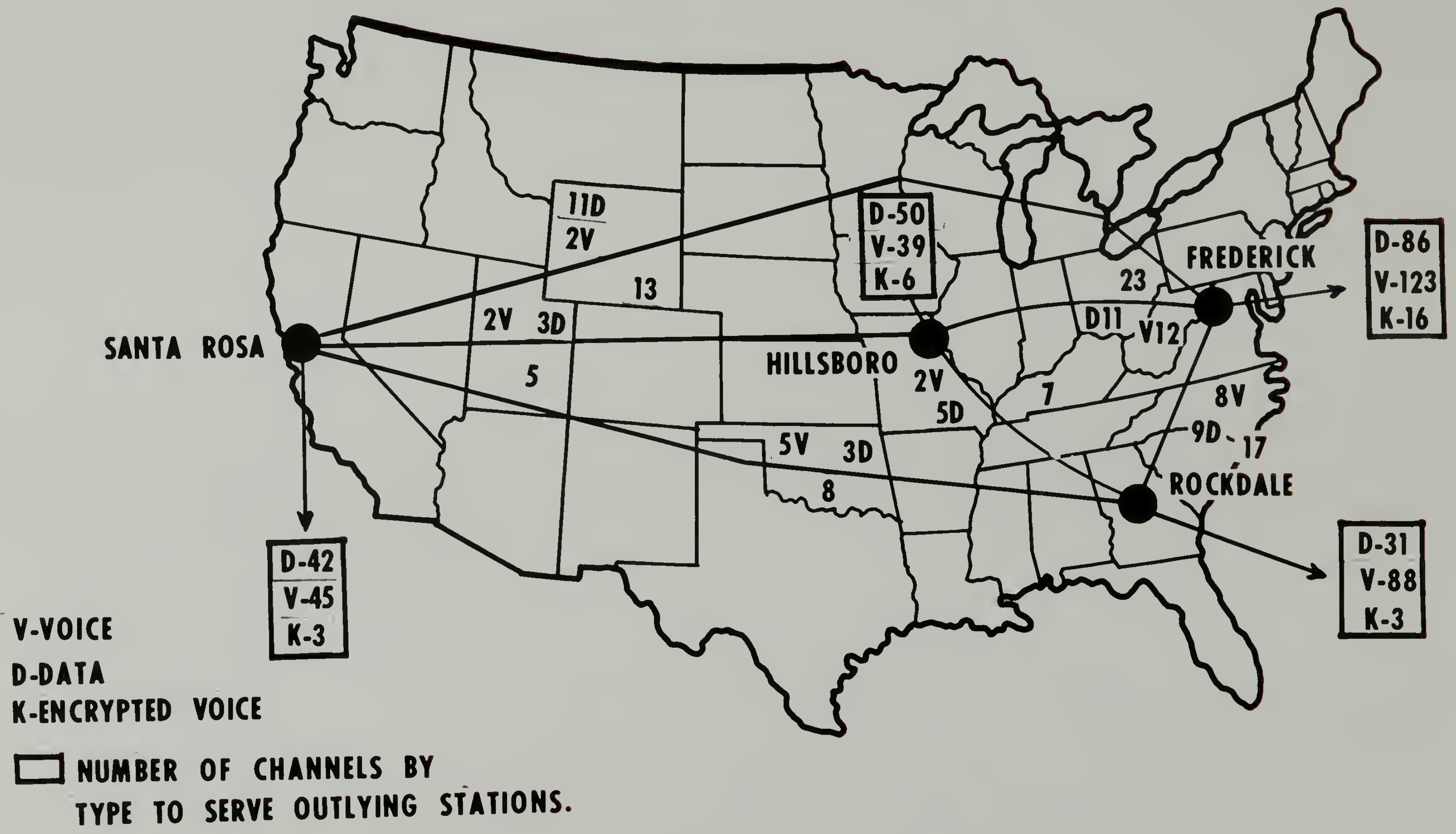
Progress made in electrical transmission of data has afforded a tremendous improvement in reducing the time required for communications. Data transceiver communication networks are being extensively used by all military services particularly in the supply and logistic systems. Communication facilities have been improved through the development of punched-card communication systems which provide faster, more accurate processing of data. Transmission of data by faster methods is now in the development and testing stages.

The full development of an integrated, streamlined system in the Marine Corps will require an increase in communication capabilities commensurate with the improvements in automatic data processing systems to provide the most effective management control.

Activation of the Army Signal Corps Switched Circuit Automatic Network,(SCAN) Figure 4, provides a rapid, reliable, and flexible system of communication for voice, data, and facsimile subscribers. It utilizes automation in order to handle

FIGURE 4

SWITCHED CIRCUIT AUTOMATIC NETWORK



SCAN

the increasing traffic load and has the inherent capability of meeting inevitable changes in requirements as they occur.[43]

The Marine Corps transceiver network provides for the transmission of punched-card data regarding requisitions and other transactions between the stock accounts and the supply center. The supply centers and the inventory control point utilize the SCAN system which provides for rapid transmission of data as required by the integrated supply automatic data processing system. The system enables a requisition to flow from the stock account to the supply center via the Marine Corps transceiver network to the inventory control point via Army SCAN all in a matter of a few minutes. Figure 5 illustrates how the Marine Corps supply transceiver network is connected to Army SCAN.

The system is a significant step forward and will undoubtedly increase in importance with the advent of the new Defense Supply Agency. Future requirements will make it necessary that data be transmitted not only internally within the Marine Corps supply system but also from supply centers and the inventory control point to certain Defense Supply Agency stocking points.

It might be apropos at this point to mention the fact that, in addition to the Marine Corps transceiver network, the inventory control point at Philadelphia is connected directly

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[43] Bell System, Switched Circuit Automatic Network, Report prepared for the U.S. Army Signal Corps by Longlines Department of the American Telephone & Telegraph Company.

FIGURE 5

MARINE CORPS DATA TRANSCEIVER NETWORK

◆ ARMY SWITCHED CIRCUIT AUTOMATIC NETWORK (SCAN)

● MARINE CORPS SUPPLY CENTER

▼ MARINE CORPS STOCK ACCOUNTS

to certain defense supply integrated managers at various locations throughout the United States. This requirement for data to be transceived between the Marine Corps and the integrated manager will be expanded considerably in the future.

Defense Supply Agency

The impact of the Defense Supply Agency upon the Marine Corps has yet to be felt; however, it is visualized that within a period of three years, the Corps may depend on up to ninety per cent of its logistical support from defense supply integrated managers.[44] The large part of all material requirements will be satisfied through the distribution system of the Defense Supply Agency. The distribution system is not yet firm, but it has been established in the form of recommendations that thirty-seven installations be incorporated in the defense supply integrated manager distribution system. (See Figure 6). This recommendation was based upon an analysis made by the Army and Navy.

The emergence of the Defense Supply Agency and their integrated managers will have a tremendous impact upon the Marine Corps and will have a profound effect on the overall distribution system. It will require a complete examination of current procedures which, providentially, have been designed for ease in adjustment. The Marine Corps support concept can continue as it exists today, but adjustments will be required in the procedures

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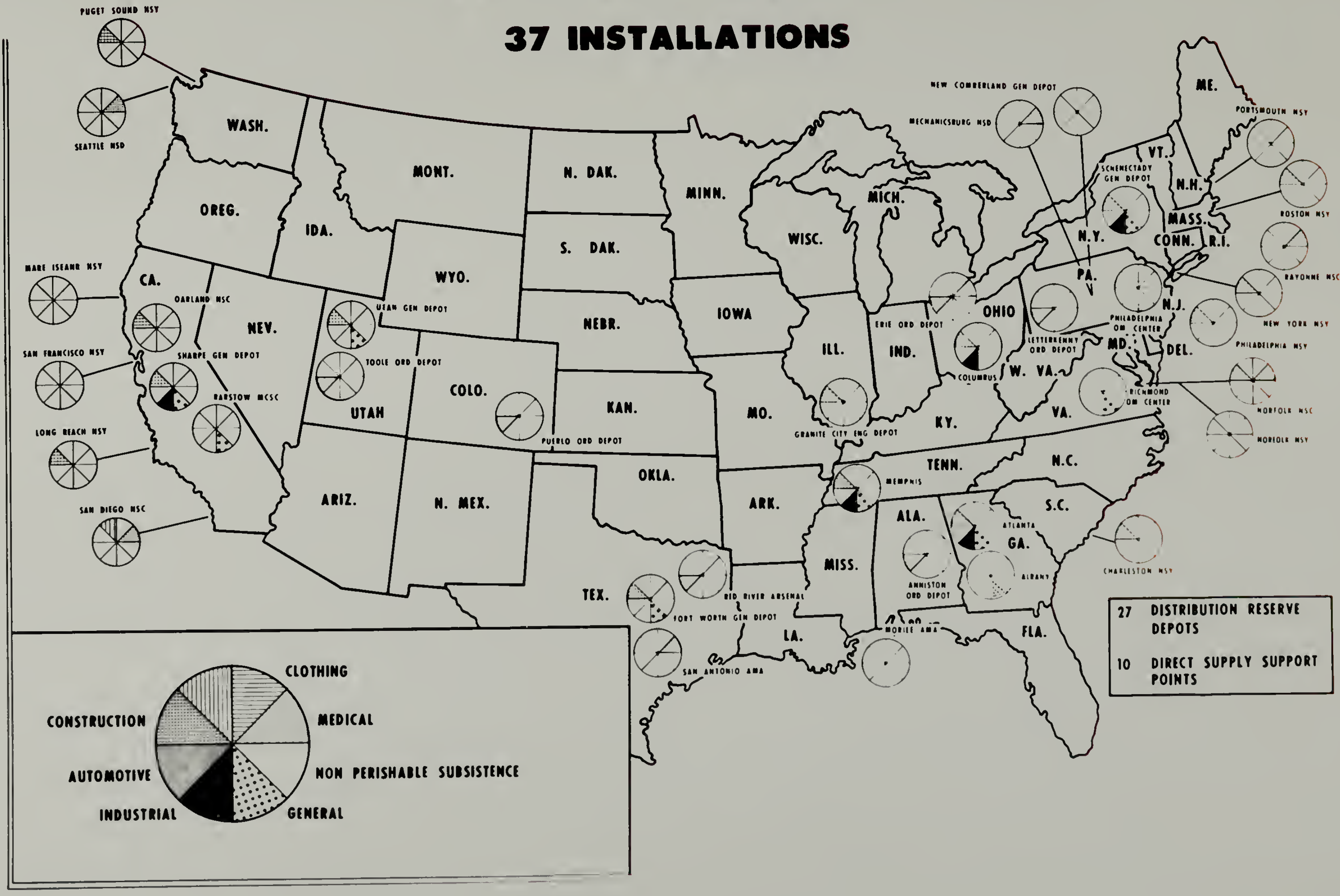
[44] Clifton M. Craig, Colonel, USMC, Analysis Staff, Armed Forces Supply Support Center, Washington, D.C., in an address before students of the Navy Graduate Financial Management Program, The George Washington University, November, 1961.

FIGURE 6

RECOMMENDED WHOLESALE INTEGRATED MANAGER DISTRIBUTION SYSTEM

BASED ON ARMY-NAVY RECOMMENDATIONS

37 INSTALLATIONS



of requesting support for the integrated managers. It is felt that the Marine Corps supply center will be required to deal directly with the integrated manager responsible for the type of material required. The integrated manager can ship directly to the stock account requiring the material. This will allow the material to flow directly from the integrated manager distribution point to stock accounts and, at the same time, control is maintained at the supply center level in accordance with the basic Marine Corps supply concept.

The Marine Corps has adopted the Department of Defense priority system which has been designed and approved by the Joint Chiefs of Staff. It is unknown at the present time what the requirement will be for a standard requisitioning format. It is felt that adjustments can be made to the current format in order to meet the new requirement without drastic change.

The current Marine Corps automatic data processing system will have to be examined and adjusted where necessary to insure compatability with the Defense Supply integrated manager system. There will be a need for master planning for the development of a fully integrated system. Parameters of the master plan will have to be established by the Defense Supply Agency if full potential of the advanced systems are realized.

There are many problems to be overcome in the development of integrated systems. Data transmission, information retrieval, management training and the like all require consideration in this total systems approach. The flow of data in the Defense Supply Agency operations involves data origination and

processing through a complex network of organizations and activities. Regardless of the approach taken, the Marine Corps will be prepared to meet the challenge. The current system is flexible and undoubtedly can be modified within a relatively short period of time to insure compliance with the Defense Supply Agency without interruption of supply support to the Fleet Marine Forces.

Information Retrieval

The use of more extensive and sophisticated automatic data processing systems has made a profound change in the way a military supply and logistic manager does business. Management reports of all sizes and shapes with data of all descriptions flood his office daily, yet one important and related area of computer potential remains virtually untapped by management. This is the area of information storage and retrieval.

Information retrieval is the art of extracting from storage that information desired at a particular point in time in response to specific requests. Mr. John Veyette, author of an article in the Data Processing Magazine, further states therein: "While the term retrieval connotes the act of 'regaining' or 'recovering' the information, the retrieval concept extends beyond this to such things as information collection, selection, indexing, storage, retrieval and dissemination."[45]

Information retrieval must be considered as one, integrated function of an active, dynamic, communications network.

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[45] John H. Veyette, Jr., "Information Retrieval," Data Processing, January 1962, p. 11.

Improper communication between management and the technician has caused some stumbling blocks with computer usage in the past. It is mostly a matter of not fully comprehending one another's language. Management oftentimes has difficulty in describing the requirements of their position and the kinds of information they could best employ.

Computer manufacturers and communication companies are recognizing that it is not just the hardware but also the information system that is valuable in helping to solve management problems. With this in mind, Remington Rand Univac recently completed an information storage and retrieval system for the Armed Forces Technical Information Agency which, with the aid of a Univac Solid State 90 Computer, will greatly expedite research through a mass of technical material.

This information retrieval system is a tremendous step forward and, when fully developed, will provide management with timely up-to-date information to non-statistical and/or non-financial information essential to rational decision making. Electronic computers of the past and present have been of tremendous value primarily in supplying management with statistical reports about internal operations. The forthcoming information retrieval system can pick up where routine data processing leaves off.[46]

Tactical Computer

Numerous experiments have been undertaken in the past by both the Army and Marine Corps to develop an automatic data

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[46] John T. Jackson, "Information Systems for Management Planning, " Data Processing, March 1962, p. 25.

processing system suitable for field use. The Army has, under present development, a tactical computer to be used in its family of automatic data processing devices for such field use. The Marine Corps currently has mobile data processing platoons authorized for all Fleet Marine Force service units; however, experience to date has determined that the system requires further refinement. Prior to authorizing these mobile platoons for field use, tests were successfully conducted on the West Coast at Camp Pendleton, California. However, upon actual field use of this equipment under such extreme climatic conditions as found in Okinawa, numerous equipment malfunctions resulted. In addition, the van shelter was not designed specifically for data processing equipment and many subsequent maintenance problems were encountered.

The tactical computer being developed for the Army by Philco Corporation is currently in the final testing stage. It would be reasonable to assume from test results to date that this will be a highly reliable field system. This Philco computer system, known as "Basicpac," is a rugged, mobile, solid-state data processing system, and is being developed in conjunction with the U.S. Army Signal Corps for use in forward area tactical situations. Basicpac could be a very important part of an integrated automatic data processing system for field use by all military forces for such uses as logistics, administration, intelligence, command support, and fire support.

Basicpac can be transported and operated in a S-109 shelter mounted on a 2½-ton truck or operated from a fixed installation. This unique system is designed to meet all military specifications

for shelter-mounted, air and truck transportable equipment and will be both highly reliable and easily operated under extreme field conditions. Incorporated throughout the design are the latest technological advances in solid state circuitry. This makes a compact, flexible, and highly mobile automatic data processing system completely adaptable to all environmental and climatic extremes experienced by the military.

The Basicpac system will be an extremely valuable addition to the Army family of equipment and can be readily adapted to the Marine Corps automatic data processing system. It can easily replace the tabulating equipment currently used by the mobile data processing platoon and will, no doubt, contain even more capacity than is essentially required. This would give the field commander a reliable automatic data processing system to process current data along with the necessary flexibility for experimentation with new logistics, tactics, and administration concepts.

New concepts of organization and doctrine being developed and incorporated into the Marine Corps Air Ground Team Concept demand radical changes and improvements in the systems of supply, manpower, and administration in support of the Fleet Marine Force. It is felt that, up to the present, Basicpac is the best management tool to accomplish this job.

Conclusions

Future designers of the Marine Corps automatic data processing system should anticipate a Corps-wide, universal, digital communication system. Flexibility of data flow will allow rapid exchange to and from any Marine Corps activity on a Corps-wide

basis. A completely integrated automatic data processing system that will meet all data processing requirements of the Marine Corps should be developed at the earliest practicable date.

It has been recognized that an appraisal of the Marine Corps data processing program is required as evidenced by a recent feasibility study group which was authorized to determine the selection of card type computers for use at major data processing installations. The results of this study group concluded that it will be economically feasible to replace electric accounting machine equipment with modern sophisticated IBM 1401 card computer systems. The recommendations have been approved and the major Marine Corps data processing installations will be equipped in the near future with IBM 1401 card computers. This is a step in the right direction; however, the pace should be accelerated. The entire Marine Corps data processing system should be evaluated to determine optimum data reporting and processing cycles. Planning should be undertaken to develop an integrated system for the consolidation of reporting and management control systems taking into consideration the interrelationships of program planning, budgeting, accounting, reporting, and analysis operations.

The total management system approach in which all functional subdivisions are viewed as parts of an interrelated whole should be followed. Emphasis should be placed on management objectives and informational requirements. Specifications for the kind of equipment to be used should be developed as an outgrowth of these objectives and requirements. It was stressed during personal interviews that the Marine Corps big mistake is "the

selection of two different types of computers which are not compatible for supply management and personnel management." Planning for a total system approach for the development of a fully-integrated system will avoid errors of this type in the future.

The total system approach should be developed around the Marine Corps supply management and personnel management system. The integrated system should include all supply, logistic, intelligence, financial, and other supporting services. Data should be generated at succeeding echelons from the lowest to the highest level. It is reasonable to assume that automatic data processing and high-speed communication networks must be integrated at all echelons for greater responsiveness and quicker reaction to consumer demands at all levels.

The lower echelons must have equipment which is capable of being used in combat areas. The general characteristics of ruggedness and transportability by aircraft and ground vehicles are required. The computer should have the building-block design characteristic to provide varying capacity required at different echelons of employment and flexibility under changing work loads. The computer should be designed with a maximum number of standardized plug-in type components that can be readily replaced.

Millions of transactions flow between industry operations and the military each year. Many of these transactions are initially recorded on magnetic tapes by industry for its own use. This is a tremendously underdeveloped area whereby, through joint and coordinated effort, a system could be developed to conceivably

save millions of dollars. Future Marine Corps computer centers should be compatible with other military and commercial communication systems. Some progress has been made, but there is still a long way to go. The latest advance in this area is the introduction of COBOL (Common Business Oriented Language). The idea behind COBOL is to break down today's technical barrier between the manager requesting the information and the machine providing it. To get the most out of its investment in this revolutionary equipment, top management will be required to give its enthusiastic backing. With the interest of top management, a total system approach can provide for a fully developed, integrated automatic data processing system.

This automatic data processing system designed for the Marine Corps will represent another step forward for the Corps in its never-ending search for ways to keep the Marine Corps "the best for defense at the least in expense."[47]

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[47] W. P. Battell, Brig.Gen., USMC, "An Electronic Network for Better Defense," Systems, March-April, 1959, p. 3.

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